2023-1173, 2023-1179, 2023-1180 and 2023-1191

United States Court of Appeals for the Federal Circuit

KOSS CORPORATION,

Appellant,

– v. –

BOSE CORPORATION,

Cross-Appellant.

On Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Nos. IPR2021-00612 and IPR2021-00680

BRIEF FOR APPELLANT

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MARCH 6, 2023

U.S. Patent 10,469,934

1. A headphone assembly comprising:

first and second earphones, wherein each of the first and second earphones comprises an acoustic transducer; and

an antenna for receiving wireless signals from a mobile, digital audio player via one or more ad hoc wireless communication links;

a wireless communication circuit connected to the antenna, wherein the wireless communication circuit is for receiving and transmitting wireless signals to and from the headphone assembly;

a processor;

a memory for storing firmware that is executed by the processor;

a rechargeable battery for powering the headphone assembly; and

a microphone for picking up utterances by a user of the headphone assembly; and

wherein the headphone assembly is configured to play, by the first and second earphones, digital audio content transmitted by the mobile, digital audio player via the one or more ad hoc wireless communication links;

wherein the processor is configured to, upon activation of a user-control of the headphone assembly, initiate transmission of a request to a remote, network-connected server that is in wireless communication with the mobile, digital audio player; and

wherein the headphone assembly is for receiving firmware upgrades transmitted from the remote, network-connected server.

54. The headphone assembly of claim 1, wherein each of the first and second earphones comprise: an antenna for receiving wireless signals from the mobile, digital audio player via the one or more ad hoc wireless communication links; a wireless communication circuit connected to the antenna, wherein the wireless communication circuit is for receiving and transmitting wireless signals to and from the headphone assembly; a processor; a memory for storing firmware that is executed by the processor; and a rechargeable battery for powering the headphone

assembly.

55. The headphone assembly of claim 54, wherein each of the first and second earphones comprise an earbud.

56. The headphone assembly of claim 55, wherein the processor of each of the first and second earphones comprises a digital signal processor that provides a sound quality enhancement for the audio content played by the acoustic transducer of the earphone.

57. The headphone assembly of claim 56, wherein the processor of each of the first and second earphones comprises a baseband processor circuit that is in communication with the wireless communication circuit of the earphone.

U.S. Patent 10,206,025

1. A system comprising:

a mobile, digital audio player that stores digital audio content; and

a headphone assembly, separate from and in wireless communication with the mobile digital audio player, wherein the headphone assembly comprises:

first and second earphones, wherein each of the first and second earphones comprises an acoustic transducer;

an antenna for receiving wireless signals from the mobile, digital audio player via one or more ad hoc wireless communication links;

a wireless communication circuit connected to the at least one antenna, wherein the at least one wireless communication circuit is for receiving and transmitting wireless signals to and from the headphone assembly;

a processor;

a rechargeable battery for powering the headphone assembly; and

a microphone for picking up utterances by a user of the headphone assembly; and

a remote, network-connected server that is in wireless communication with the mobile, digital audio player;

wherein the mobile, digital audio player is for transmitting digital audio content to the headphone assembly via the one or more ad hoc wireless communication links, such that the digital audio content received by the headphone assembly from the mobile, digital audio player is playable by the first and second earphones; and

wherein the processor is for, upon activation of a user-control of the headphone assembly, initiating transmission of a request to the remote, network-connected server.

11. The system of claim 1, wherein: the wireless communication circuit is located in the first earphone; and the headphone assembly further comprises a connection wire between the first and second earphones to carry the received digital audio

content from the first earphone to the second earphone.

29. The system of claim 11, wherein each of the first and second earphones comprises: an adjustable, curved hanger bar that sits upon an upper external curvature of a user's ear, behind the an upper portion of an auricula of the user's ear, when the headphone assembly is worn by the user; and a body connected to the hanger bar, wherein the earphone extends from the body into the user's ear when the headphone assembly is worn by the user.

40. The system of claim 1, wherein each of the first and second earphones comprises: at least one acoustic transducer; a wireless communication circuit; a body portion that sits at least partially in an ear of the user when the headphone assembly is worn by the user; and an elongated portion that extends from the body portion.

53. The system of claim 1, wherein each of the first and second earphones comprises: an adjustable, curved hanger bar that sits upon an upper external curvature of a user's ear, behind the an upper portion of an auricula of the user's ear, when the headphone assembly is worn by the user; and a body connected to the hanger bar, wherein the earphone extends from the body into the user's ear when the headphone assembly is worn by the user.

UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

CERTIFICATE OF INTEREST

Case Number 2023−1173, 2023−1179, 2023−1180, 2023−1191

Short Case Caption Koss Corp. v. Bose Corp.

Filing Party/Entity Koss Corp.

Instructions: Complete each section of the form. In answering items 2 and 3, be specific as to which represented entities the answers apply; lack of specificity may result in non-compliance. **Please enter only one item per box; attach additional pages as needed and check the relevant box**. Counsel must immediately file an amended Certificate of Interest if information changes. Fed. Cir. R. 47.4(b).

I certify the following information and any attached sheets are accurate and complete to the best of my knowledge.

Date: March 6, 2023

Signature: /s/ *Mark G. Knedeisen*

Name: Mark G. Knedeisen

1. Represented Entities. Fed. Cir. R. 47.4(a)(1).	**2. Real Party in Interest.** Fed. Cir. R. 47.4(a)(2).	**3. Parent Corporations and Stockholders.** Fed. Cir. R. 47.4(a)(3).
Provide the full names of all entities represented by undersigned counsel in this case.	Provide the full names of all real parties in interest for the entities. Do not list the real parties if they are the same as the entities. ☒ None/Not Applicable	Provide the full names of all parent corporations for the entities and all publicly held companies that own 10% or more stock in the entities. ☒ None/Not Applicable
Koss Corp.		

☐ Additional pages attached

4. Legal Representatives. List all law firms, partners, and associates that (a) appeared for the entities in the originating court or agency or (b) are expected to appear in this court for the entities. Do not include those who have already entered an appearance in this court. Fed. Cir. R. 47.4(a)(4).

☐ None/Not Applicable ☐ Additional pages attached

Laurén Murray		

5. Related Cases. Provide the case titles and numbers of any case known to be pending in this court or any other court or agency that will directly affect or be directly affected by this court's decision in the pending appeal. Do not include the originating case number(s) for this case. Fed. Cir. R. 47.4(a)(5). See also Fed. Cir. R. 47.5(b).

☐ None/Not Applicable ☐ Additional pages attached

Koss Corp. v. Skullcandy, Inc., Nos. 2:21–cv–00203 (D. Utah)
Koss Corp. v. PEAG LLC, No. 3:21–cv–01177 (S.D. Cal.)
Koss Corp. v. Plantronics, Inc., No. 4:21–cv–03854 (N.D. Cal.)
Koss Corp. v. Bose Corp., No. 1:20−cv−12193 (D. Mass.)

6. Organizational Victims and Bankruptcy Cases. Provide any information required under Fed. R. App. P. 26.1(b) (organizational victims in criminal cases) and 26.1(c) (bankruptcy case debtors and trustees). Fed. Cir. R. 47.4(a)(6).

☒ None/Not Applicable ☐ Additional pages attached

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STATEMENT OF RELATED CASES

This consolidated appeal arises from final written decisions ("FWDs") by the Patent Trial and Appeal Board in IPR2021–00680 concerning U.S. Patent No. 10,469,934 ("the '934 Patent") and in IPR2021–00612 concerning U.S. Patent No. 10,206,025 ("the '025 Patent"). Both patents are assigned to Koss Corporation ("Koss"), who is the Appellant. The petitioner for both *inter partes* review (IPR) proceedings was Bose Corporation ("Bose"), who is the Cross-Appellant.

This appeal may affect the following pending litigations involving the '934 and/or '025 Patents: *Koss Corp. v. Bose Corp.*, No. 1:20−cv−12193 (D. Mass.); *Koss Corp. v. PEAG LLC*, No. 3:21–cv–01177 (S.D. Cal.); *Koss Corp. v. Plantronics, Inc.*, No. 4:21–cv–03854 (N.D. Cal); and *Koss Corp. v. Skullcandy, Inc.*, No. 2:21–cv–00203 (D. Utah).

The following pending Federal Circuit appeals involve patents in the same family as the '934 and '025 Patents: *Koss Corp. v. Vidal*, Case Nos. 2022−2091, −2115; and *Koss Corp. v. Bose Corp.*, Case No. 2022–2090 (Fed. Cir.). This Court ordered that all of these appeals "shall be treated as companion cases and assigned to the same merits panel." *Koss Corp. v. Bose Corp.*, Case No. 2022–2090, Dkt. 16 (Fed. Cir. Dec. 20, 2022).

JURISDICTIONAL STATEMENT

The Board had jurisdiction under 35 U.S.C. §§ 311–315, and issued its FWDs on September 13, 2022, for the '025 Patent in IPR2021–00612 (Appx138−225), and on October 7, 2022, for the '934 Patent in IPR2021–00680 (Appx1−137). Koss filed Notices of Appeal on, respectively, November 15, 2022, for IPR2021–00612 and November 17, 2022, for IPR2021–00680. Appx12345−12347; Appx1453−1455. Bose filed its Notices of Cross-Appeal on November 16, 2022 and November 18, 2022, respectively. Appx12439−12441; Appx1596−1598. This Court has jurisdiction under 35 U.S.C. §§ 141–144, 319 and 28 U.S.C. § 1295(a)(4)(A).

STATEMENT OF THE ISSUES

1. Whether, in concluding that claims 40–43, 46, 48, 51 of the ’025 Patent are unpatentable under 35 U.S.C. § 103 under Bose’s Ground 1F for the ’025 Patent, the Board erred as a matter of law in its construction of the claim term “body portion” in claim 40 and that such error was not harmless.

2. Whether, in concluding that claims 29–31, 34, 36 and 53 of the ’025 Patent are unpatentable under § 103, the Board erred as a matter of law in its construction of the claim term “extends from” in claims 29 and 53 and that such error was not harmless.

3. Whether substantial evidence supports the Board’s determination that claims 56 and 57 of the ’934 Patent are unpatentable under § 103.

STATEMENT OF THE CASE

I. THE ’025 AND ’934 PATENTS

The ’025 and ’934 Patents are assigned to Koss. Each patent claims priority via several continuation applications to a PCT application, PCT/US2009/039754, filed April 7, 2009, and to a provisional application, Serial No. 61/123,265, filed April 7, 2008. Appx258−259; Appx226−227. The two patents, which disclose various types of wireless earphones, have identical written descriptions and figures.

A. <u>The Disclosures of the Patents</u>

The patents describe various functional features for wireless earphones, such as transitioning automatically between wireless networks (Appx281−282, 10:46−11:61), signal processing, including noise cancellation, in the wireless earphones (Appx280, 7:26−33), and firmware upgrades pushed to the wireless earphones (Appx281, 9:41−10:3).[1] The patents also describe various earphone form factors, including independently wireless earphones, i.e., discrete earphones that are not physically connected when worn by a user and that are each wireless. Appx261, Figs. 1A−1B; Appx263, Figs, 1D−1E; Appx278, 3:11−50. Such independently wireless earphones are often referred to as “true wireless” or “TWS” earphones.

[1] Citations to disclosures in the ’025 and ’934 Patents herein are to the ’025 Patent unless otherwise noted for sake of simplicity as the specifications and drawings of the two patents are identical.

Appx11286−11287, ¶32; Appx11359−11360, ¶¶9−11; Appx20302−20303, ¶32; Appx20369−20370, ¶¶9−11.

The patents describe two general types of wireless networks via which the wireless earphones can stream content: "ad hoc" and "infrastructure" wireless networks. According to the patents, an ad hoc wireless network is "a network where two (or more) wireless-capable devices … communicate directly and wirelessly, without using an access point." Appx278, 3:2−5. Bluetooth is an example of an ad hoc wireless link. *Id.*, 4:54−59. An infrastructure wireless network, on the other hand, "is a wireless network that uses one or more access points to allow a wireless-capable device, such as the wireless earphone, to connect to a computer network, such as a LAN or WAN (including the Internet)." *Id.*, 3:5−10.

The wireless earphones disclosed in the patents may stream, via a wireless network, digital audio content from various sources, such as a mobile, digital audio player ("DAP"), a laptop, or a server connected to the Internet. *Id.*, 4:24−34. To receive and play the streamed content, each wireless earphone comprises a "transceiver circuit," which may be implemented as a single integrated circuit, such as a system-on-chip ("SOC"). Appx158, 3:46−48; Appx279–280, 6:26–8:4; Appx268, Fig. 3. Using a SOC in the earphones "is conducive to miniaturizing the components of the earphone, which is advantageous if the earphone is to be relatively small in size, such as an in-ear earphone (see FIGS. 1A–1B for example)."

Appx279, 6:43−46 (reference numbers omitted).

With reference to Figure 3 of the patents, reproduced below, the transceiver circuit 100 includes a processor 114, which can include a digital signal processor ("DSP") 118. Appx280, 7:26−28. The DSP may "perform various sound quality enhancements" for the earphone, such as "noise cancellation and sound equalization." *Id.*, 7:30−33. The processor can execute firmware, which is stored in a memory 120, 122 of the transceiver circuit, to implement the various functionalities described in the patents for the wireless earphones, such as transitioning between wireless networks. *Id.*, 7:42−45. Dependent claims (in particular, claims 56 and 57 of the '934 Patent) directed to TWS earbuds, with a DSP in each earbud, where the DSP provides a sound quality enhancement for audio content played by the earbud, are subject to this appeal.

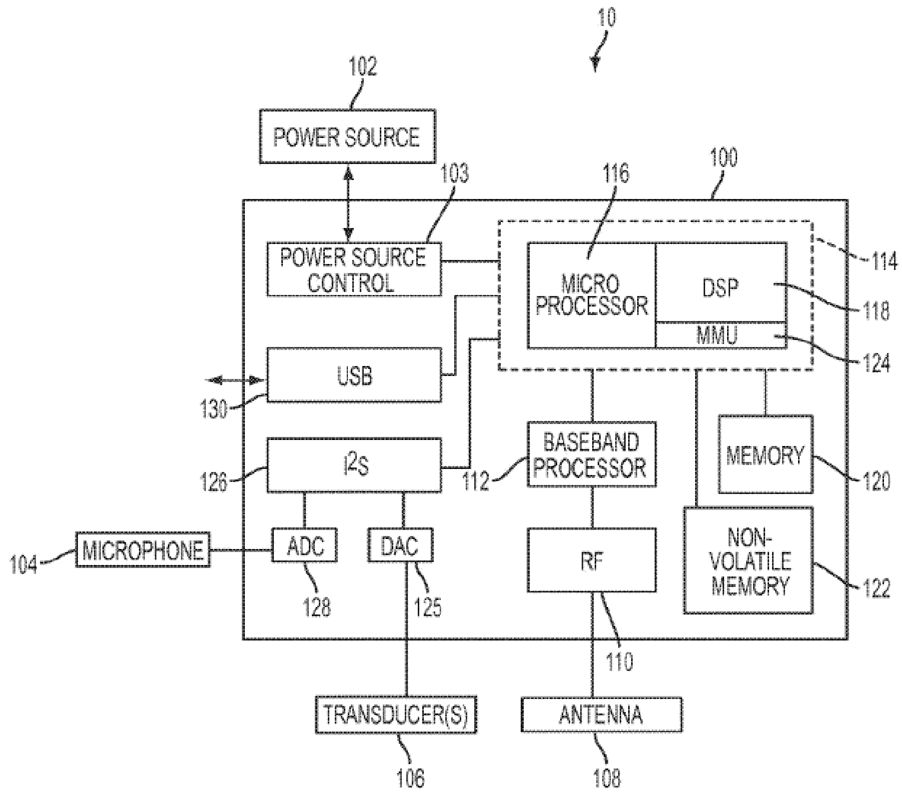

FIG. 3

Among the functions that the firmware can implement for the earphones is transitioning between audio sources. If the earphones are streaming content from a first audio source on a first network (or communication link), the earphones can switch to streaming content from another, second audio source on a second network. Appx279, 5:7−67; Appx281−282, 10:4−11:61; Appx271, Fig. 6. The earphones may transition sources when, for example, the earphones become out of range with the first audio source, provided that the second audio source is in range (e.g., has a sufficiently strong signal strength) via the second network. Appx279, 5:7−14; Appx281, 10: 4−35.

The patents describe two TWS earphone form factors: (1) an earphone with a "hanger bar" that extends over the top of the user's ear (Appx263, Figs. 1D–1E; Appx278, 3:66−4:204:4–25); and (2) an earphone with both a "body portion" and an "elongated portion" extending from the body portion (Appx261, Fig. 1B; Appx278, 3:11−27). For simplicity, these two form factors are referred to herein as the "hanger bar" and "elongated portion" form factors respectively. Dependent claims directed to these form factors are subject to this appeal.

Figures 1D–1E of the patents (reproduced below) show the hanger bar form factor type. In this form factor type, the hanger bar 17 allows the earphone 10 "to clip to, or hang on, the user's ear …." Appx278, 3:66−4:1. The hanger bar is connected at one end to a body 12 of the earphone and the other end "rests upon the upper external curvature of the listener's ear behind the upper portion of the auricula (or pinna)." *Id.*, 4:11−13. The specification shows that the wireless earphone includes a "dual element" speaker, with speakers 106−A and 106−B, where the smaller speaker 106−A is inserted into the "covum concha of the listener's ear" and the larger speaker 106−B is not. *Id.*, 4:5−8.

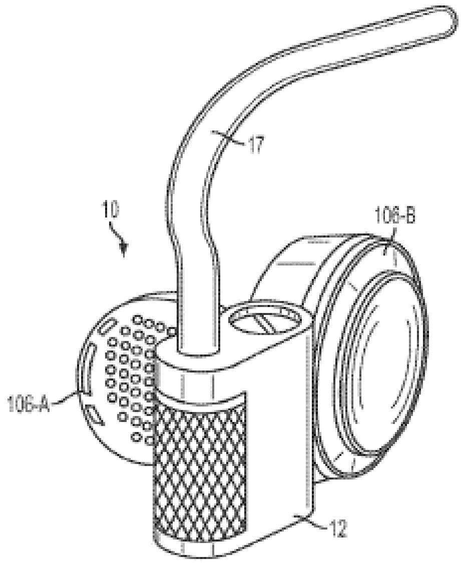

FIG. 1D

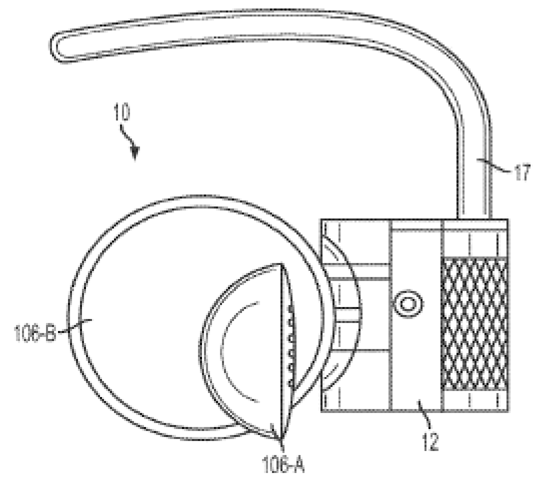

FIG. 1E

Figure 1B (reproduced below) shows the elongated portion form factor type. This earphone includes a body portion 12, which comprises an ear canal portion 14 that is inserted into the user's ear. Appx278, 3:15−18. The body portion 12 also includes an exterior portion 15, which is not inserted into the user's ear. *Id.*, 3:19−20. An elongated portion extends downwardly from the body portion when worn by a user.

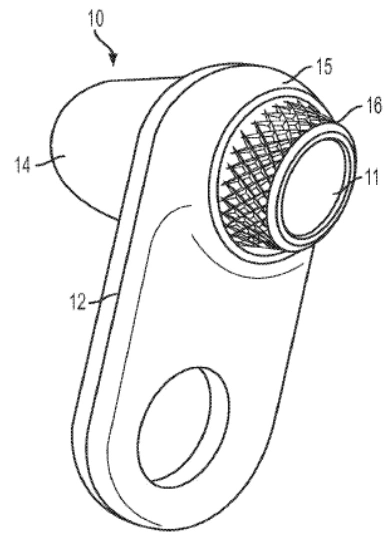

FIG. 1B

The transceiver circuit may be housed in the body portion of the wireless earphone for each form factor type. Appx278, 3:31−47.

B. <u>The Claims of the Patents</u>

The ’025 Patent contains fifty-six (56) claims, with claim 1 being the sole independent claim. The ’934 Patent includes sixty-two (62) claims, of which claims 1 and 58 are independent.[2]

Claim 1 of the ’025 Patent is directed to a system that comprises a mobile DAP that stores digital audio content; a remote, network connected server that is in wireless communication with the DAP; and a headphone assembly that is in wireless communication with the DAP "via one or more ad hoc wireless communication links." The headphone assembly comprises first and second earphones, with each

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[2] Bose challenged all claims of the ’025 Patent, but not all claims of the ’934 Patent, as explained below. Appx139; Appx2.

including an acoustic transducer. The headphone assembly also comprises an antenna, a wireless communication circuit, a processor, a rechargeable battery, and a microphone. The DAP transmits digital audio content to the headphone assembly via the one or more ad hoc wireless communication links so that the headphone assembly can play the digital audio content. The processer of the headphone assembly, "upon activation of a user control of the headphone assembly," "initiat[es] transmission of a request to the remote, network-connected server." Appx285, 18:2–33.

Claim 1 of the '934 Patent is directed to a "headphone assembly" and is similar to claim 1 of the '025 Patent. Like claim 1 of the '025 Patent, the headphone assembly of claim 1 of the '934 Patent communicates with a DAP "via one or more ad hoc wireless communication signals." Also like claim 1 of the '025 Patent, the processor of the headphone assembly of claim 1 of the '934 Patent, "upon activation of a user control of the headphone assembly," "initiat[es] transmission of a request to the remote, network-connected server." In addition, claim 1 of the '934 Patent discloses that the headphone assembly "receiv[es] firmware upgrades transmitted from the remote, network-connected server." Appx253, 18:2–33.

Independent claim 58 of the '934 Patent and claim 1 of the '934 Patent share similar elements. The relevant difference between the claims is as follows: claim 1 recites that the headphone assembly "is for receiving firmware upgrades transmitted

from the remote, network-connected server," whereas claim 58 recites that the headphone assembly "transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link," where "the second digital audio source is different from" the mobile DAP (i.e., the "first digital audio source" in claim 58). Appx256, 24:30–67. In the FWDs, the Board referred to claims in both patents which recite transitioning from the first digital source to the second digital source based on, at least, the signal strength for the second wireless communication link, like claim 58, as the "Signal Strength claims." Appx181; Appx47. Koss uses that same naming convention herein. In addition to independent claim 58, the ’934 Patent includes Signal Strength claims that depend, directly or indirectly, from claim 1. Appx253–256, claims 4, 6, 8, 12, 13, 17, 18, 20, 22, 38, 40, 41. The ’025 Patent also includes Signal Strength claims that depend from claim 1. Appx285–288, claims 4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28, 32, 33, 35, 37, 44, 45, 47, 49, 50.

The patents also include dependent claims directed to different earphone form factor types. The hanger bar form factor dependent claims of the ’025 Patent recite "an adjustable, curved hanger bar" and "a body connected to the hanger bar." The curved hanger bar "sits upon an upper external curvature of a user’s ear, behind [] an upper portion of an auricula of the user’s ear, when the headphone assembly is

worn by the user." Appx287, claim 29; Appx288, claim 53. The earphone "extends from" the body into the user's ear. *Id*.[3]

The elongated portion form factor dependent claims, e.g., claim 40 of the '025 Patent, recite "a body portion" and "an elongated portion" that "extends from the body portion." Appx288, claim 40. The body portion "sits at least partially in an ear of the user when the headphone assembly is worn by the user." *Id*.

II. IPR PROCEEDINGS

Four IPR petitions have been filed against each of the '025 and '934 Patents, respectively. Bose filed one IPR for each patent and the Board's FWDs from those IPRs are the subject of this consolidated appeal. Apple Inc. ("Apple") filed three IPRs against each of the two patents. The Board did not issue a FWD for any of Apple's IPRs.

A. Bose as Petitioner

Bose filed its IPRs two weeks apart in March 2021. Appx11840; Appx932. The Board issued its FWDs in the fall of 2022, approximately three weeks apart. Appx1−137; Appx138−225; Appx1046−1089; Appx11959−12012.

Bose asserted similar, but not identical, grounds in the two petitions and relied

[3] The '934 Patent also includes dependent hanger bar claims—claims 23, 42 and 48 (Appx287-288)—but Bose did not challenge these claims of the '934 Patent. Appx2; Appx793.

on overlapping prior art.[4] In each IPR, Bose submitted testimony from the same two witnesses: Dr. Tim A. Williams ("Williams") and Dr. John G. Casali ("Casali"). Koss submitted testimony from Mr. Joseph C. McAlexander, III ("McAlexander") and Mr. Nicholas Blair ("Blair") in both IPRs.

In the FWDs, the Board concluded that Bose had shown by a preponderance of the evidence that some challenged claims are unpatentable, but that Bose failed to show that other challenged claims are unpatentable. Appx115; Appx139.

1. Asserted Grounds and Relied-Upon References

a. IPR2021−00612 for the '025 Patent

Bose petitioned to cancel all 56 claims of the '025 Patent based upon fourteen total grounds—Grounds 1A−H and 2A−F. Bose relied on nine total prior art references for the asserted grounds, as follows:

Ground	Claims	References
1A	1−3, 6, 8, 11−13, 16, 18, 20−22, 25, 27, 39, 52, 54−56	Rezvani-446 (Appx18389−18404)/Revzani-875 (Appx13724−13741)/ Skulley (Appx13742−13750)

[4] In Bose's petition for the '025 Patent (i.e., IPR2021-00612), Bose relied on all of the references it relied upon in its petition for the '934 Patent (i.e., IPR2021-00680). In addition, in the '025 Patent petition, Bose relied on one additional reference, Davis (Appx14263-14277), that it did not assert in its petition for the '934 Patent. Appx8-9; Appx146-147.

Ground	Claims	References
1B	4−5, 7, 9, 14−15, 17, 19, 23−24, 26, 28	Rezvani-446/Revzani-875/Skulley/Harada (Appx180405−18458)
1C	10, 38	Rezvani-446/Revzani-875/Skulley/Hind (Appx13762−13786)
1D	29−31, 34, 36, 53	Rezvani-446/Revzani-875/Skulley/ Davis (Appx14263−14277)
1E	32−33, 35, 37	Rezvani-446/Revzani-875/Skulley/ Davis/Harada
1F	40−43, 46, 48	Rezvani-446/Revzani-875/Skulley/ Davis/Oh (Appx18459−18481)
1G	44−45, 47, 49−50	Rezvani-446/Revzani-875/Skulley/ Davis/Oh/Harada
1H	51	Rezvani-446/Revzani-875/Skulley/ Davis/Oh/Hind
2A	1−3, 6, 8, 10−13, 16, 18, 38−43, 46, 48, 51−52, 54, 56	Schrager (Appx18497−18510)/Goldstein (Appx13885−13900)
2B	4−5, 7, 9, 14−15, 17, 19, 23−24, 26, 28, 44−45, 47, 49−50	Schrager/Goldstein/Harada
2C	29−31, 34, 36, 51, 53, 55	Schrager/Goldstein/Davis
2D	32−33, 35, 37	Schrager/Goldstein/Davis/Harada

Ground	Claims	References
2E	20−22, 25, 27, 39, 54−56	Schrager/Goldstein/Skulley
2F	23−24, 26, 28	Schrager/Goldstein/Skulley/Harada

Appx11711−11712; Appx11966.

The references for Grounds 1A−1H are summarized as follows:

- **Rezvani-446** − Rezvani-446 discloses a wireless headset in communication with a wireless portable media (WPM) server. Appx18393; Appx18395; Appx18398, ¶[0022]; Appx18400, ¶[0041]; Appx18401, ¶[0055]. The WPM server can provide content to the wireless headset via a wireless link. Appx18397, ¶[0004]. Rezvani-446 does not disclose any specific form factors for the wireless headset.
- **Rezvani-875** – Rezvani-875 discloses a multiple antenna, wireless headset in communication with, among other things, a handset via, for example, a WiFi (IEEE 802.11) or Bluetooth (IEEE 802.15) link. Appx13738, ¶[0042]; Appx13733. Rezvani-875 does not disclose any specific form factors for the wireless headset. Appx18401, ¶[0055]; Appx13735, ¶[0018]; Appx13086, ¶93; Appx13425−13426, ¶129.
- **Skulley** – Skulley summarizes different types of headsets, including in-

the-ear, on-the-ear and over-the-ear headsets. Appx13746, 1:21−34. Skulley, however, does not mention or describe TWS earbuds. Appx13742−13750.

- **<u>Oh</u>** – Of the prior art cited for Grounds 1A−1H, only Oh discloses TWS earbuds. Appx18462, ¶17; Appx18464, ¶30; Appx18476, Figs. 1−2. As shown in Figures 1 and 2 of Oh, reproduced below, the earbuds disclosed in Oh are sized and shaped so that the tip (referred to as "inserting unit 10" in Oh) that is inserted into the user's ear during use also fits into a mobile phone 200 for easy carrying of the earbuds with the mobile phone when the earbuds are not in use. Appx18462−18463, ¶¶15−19. Oh's earbuds also include a "main body" 20 connected to the "inserting unit" 10. Appx18464, ¶30; Appx18476, Figs. 1−2.

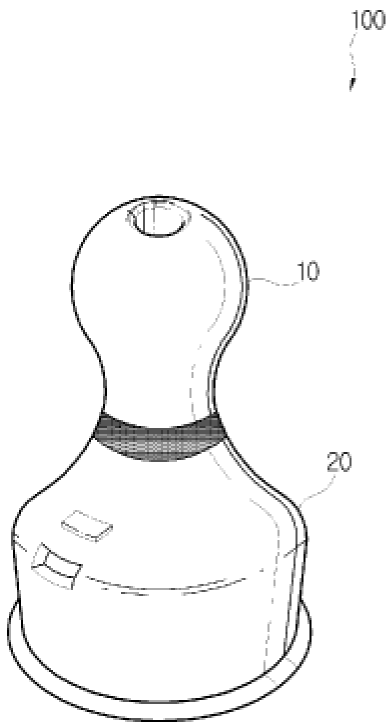

Fig. 1 of Oh

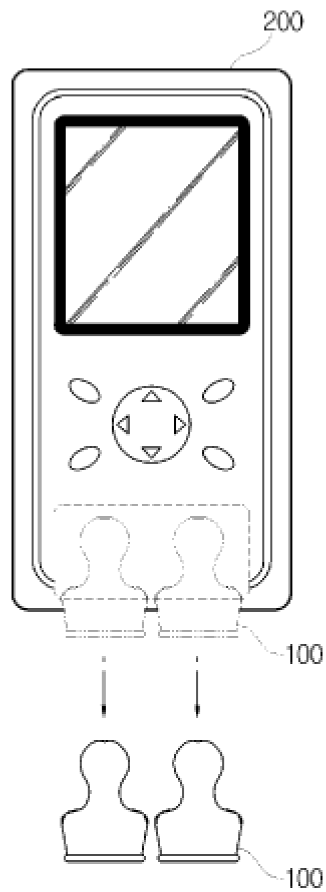

Fig. 2 of Oh

- **Davis** – As shown in Figures 1 and 2 of Davis, reproduced below, Davis discloses a wired, single-ear headset enclosure 12 with an arcuate earhook 13 and a "voice transmitter" 17 extending toward the user's mouth. Appx14264–14266, Figs. 1–3A; Appx14274, 4:38–47. An adjustably rotatable receiver enclosure 32 is connected to the headset enclosure 12. Appx14274, 4:45–62. The receiver enclosure 32 includes a socket 44 for receiving an earbud 46, which is "adapted to rest against the opening of the ear canal." Appx14275, 6:32–35. Davis

does not disclose a wireless headset or a pair of earphones, let alone a pair of wireless earphones.

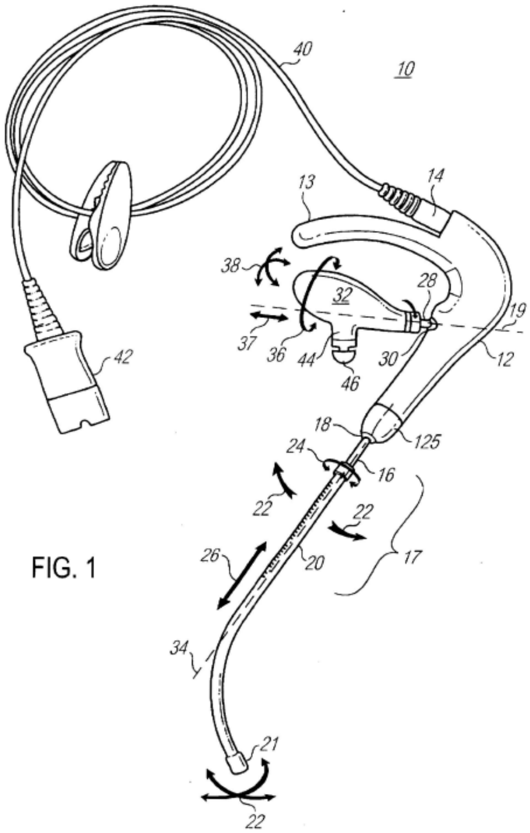
FIG. 1

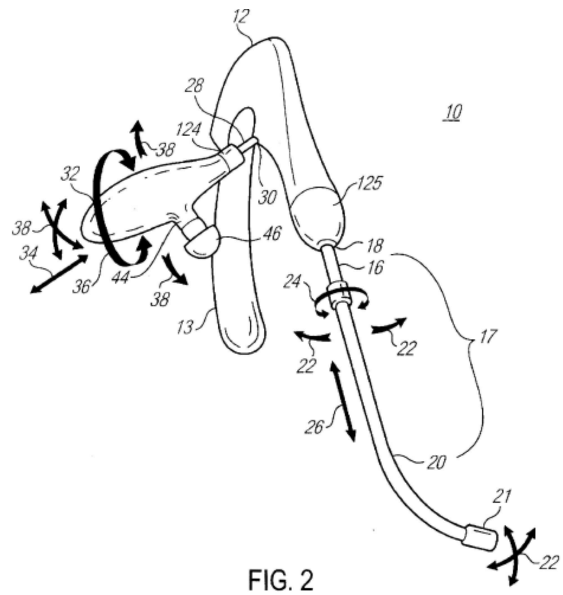
FIG. 2

Fig. 1 of Davis Fig. 2 of Davis

- **<u>Hind</u>** – Bose cited Hind in the ’025 Patent IPR for grounds (Grounds 1C and 1H) covering claims that recite firmware updates for the earphones. Hind does not disclose earphones at all. Appx13762−13786 (Hind).

- **<u>Harada</u>** – Bose cited Harada in the ’025 Patent IPR in grounds (Grounds 1B, 1E, 1G, 2B, 2D) covering the Signal Strength claims. Appx11712. Like Hind, Harada does not disclose any earphones.

Appx18405−18458 (Harada); Appx20312, ¶50.

In Grounds 2A−2F for the ’025 Patent, Bose primarily relied upon the Goldstein and Schrager references.[5] Goldstein discloses an earpiece, including TWS earbuds, with a Personal Audio Assistant. Appx13889, Fig. 5A; Appx13891, ¶[0017]; Appx13895, ¶[0069]. The Personal Audio Assistant “can be an audio playback platform for providing the user with Personalized Services,” such as content, reminders, and text-to-speech and speech-to-text processing. Appx13891, ¶[0017].

Schrager discloses a “headset unit” that communicates wirelessly with a base unit. Appx18503, 5:2−5. The headset unit can include “two earpiece portions, each having a speaker disposed therein.” Appx18503, 5:13−14. Schrager does not disclose that the headset unit might be embodied as TWS earbuds. Appx18497−18510.

b. IPR2021−00680 for the ’934 Patent

Bose petitioned to cancel claims 1−22, 32−41, 47 and 49−62 of the ’934 Patent based upon eight asserted grounds—Grounds 1A−1D, 2A−2D. Bose relied on eight total prior art references (all of which Bose relied upon in the asserted grounds for the ’025 Patent IPR) in its petition as follows:

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[5] Bose also relied upon Harada, Davis and Skulley in Grounds 2B-2F for the ’025 Patent. Appx11712.

Ground	Claims	References
1A	1−3, 5, 7, 9−11, 32−37, 39, 47, 49, 51−57	Schrager/Goldstein
1B	4, 6, 8, 12−13, 38, 40−41, 58−62	Schrager/Goldstein/Harada
1C	14−16, 19, 21, 49−51	Schrager/Goldstein/Skulley
1D	17−18, 20, 22	Schrager/Goldstein/Skulley/Harada
2A	1−3, 5, 7, 9−11, 14−16, 19, 21, 47, 49−53	Rezvani-446/Rezvani-875/Skulley/Hind
2B	4, 6, 8, 12−13, 17−18, 20, 22, 58−62	Rezvani-446/Rezvani-875/ Skulley/Hind/Harada
2C	32−37, 39, 54−57	Rezvani-446/Rezvani-875/Oh/Hind
2D	38, 40−41	Rezvani-446/Rezvani875/Oh/Hind/Harada

Appx8−9; Appx794.

The disclosures of the cited references are summarized in the preceding section about IPR2021−00612.

2. Expert Testimony

In each IPR, Bose's expert Williams testified that the challenged claims would have been obvious to a person having ordinary skill in the art ("POSA") with a particularly defined skill level (Appx13075, ¶76; Appx2321, ¶81). Bose's expert

Casali did not opine that the claims would have been obvious. Appx13423−13423, ¶126 ("… I have not been asked to opine on … the obviousness of any claim as a whole"); Appx2663, ¶131 (same). Instead, Casali "provide[d] an overview of the state of the art of the non-wireless communication aspects of wireless headphone assembly design by 2008, such as the known form-factor options for a wireless headphone assembly …." Appx13368, ¶36; Appx2602−2603, ¶36.

Koss's expert McAlexander testified that the challenged claims would not have been obvious. Appx20304−20330, ¶¶36−79; Appx11288−11317, ¶¶36−82. Somewhat analogous to Casali, Blair testified about different types of, and design considerations for, wireless headphones. Appx20367−20377, ¶¶7−21; Appx11357−11361, ¶¶7−14.

3. <u>Final Written Decisions</u>

In both IPRs, the Board found that Bose failed to establish by a preponderance of the evidence that some of the challenged claims, particularly the Signal Strength claims, of each patent were unpatentable. In both IPRs, the Board also found that Bose had established by a preponderance of the evidence that the other challenged claims were unpatentable under at least one asserted ground. Appx222−224; Appx114−115.

<u>**Person of Ordinary Skill in the Art.**</u> All of the asserted grounds involved challenges under § 103. To that end, Board resolved the skill level of the POSA to

be a person that would have had a background in wireless networks, including a bachelor's degree in electrical engineering or a related field and experience with wireless networks, and would have worked on a team including members with headphone-design experience. Appx148−150 (citing Appx11717); Appx9−13 (citing Appx798).

Signal Strength Claims. In both IPRs, the Board found that Bose failed to establish that the Signal Strength claims are unpatentable.[6] Appx222−224; Appx114−115. In so finding, the Board held that Bose did "not show that Harada teaches playing digital audio content received from multiple sources" and Bose failed to identify where Harada teaches transitioning from one generic data source to another. Appx186−187; Appx219−220; Appx52−54; Appx72. In the '025 Patent FWD, the Board's findings on the Signal Strength claims was unanimous. In the '934 Patent FWD, one judge, who was not on the panel for the '025 Patent IPR (i.e., IPR2021−00612) dissented with respect to the Signal Strength claims. Appx118−138.

Elongated Portion Dependent Claims. In the '025 Patent IPR, the Board construed the claim term "body portion" in dependent claim 40 to mean "a portion

[6] The Signal Strength claims are: claims 4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28, 32, 33, 35, 37, 44, 45, 47, 49 and 50 of the '025 Patent; and claims 4, 6, 8, 12, 13, 17, 18, 20, 22, 38, 40, 41 and 58-62 of the '934 Patent.

or section of the earphone that forms a body." Appx159. Based on this construction, the Board found that Davis's earbud 46 constitutes the claimed "body portion" and found in Bose's favor on Ground 1F for the '025 Patent. Appx204. The Board rejected Bose's assertion that Ground 2A rendered claim 40 of the '025 Patent unpatentable because the Board found that Bose had not shown the claim (or claims depending therefrom) to be obvious in view of Schrager and Goldstein. Appx216–219.

In the '934 Patent IPR, the Board found the elongated portion dependent claims (i.e., claims 34–37 and 39) unpatentable based upon Ground 2C (Rezvani-446/Rezvani-875/Oh/Hind) of the Bose petition. Appx73–84. The Board "decline[d] to reach" Ground 1A for the elongated portion dependent claims of the '934 Patent, which, like Ground 2A for the '025 Patent IPR, relied on the combination of Schrager and Goldstein. Appx37; *see also* Appx40. As noted above, the Board in the '025 Patent IPR found that Schrager and Goldstein did not render obvious the elongated portion dependent claims of the '025 Patent. Appx216–219.[7]

Hanger Bar Dependent Claims. Dependent claims 29 and 53 of the '025

[7] The Board did not invalidate some elongated portion dependent claims in each patent because they also were Signal Strength claims. Specifically, the Board found that Bose failed to prove that elongated portion dependent claims 44, 45, 47, 49 and 50 of the '025 Patent are unpatentable; and that it failed to prove that elongated portion dependent claims 38, 40 and 41 of the '934 Patent are unpatentable. Appx222-224; Appx114-115.

Patent recite an “adjustable, curved hanger bar ….” Appx287−288. These claims also recite “a body connected to the hanger bar, wherein the earphone ***extends from*** the body in the user’s ear ….” *Id.* The Board construed “extends from” to mean that the earphone can extend ***indirectly*** from the body. Appx197−199. Under that construction, the Board found that Bose had shown that claims 29 and 53 (as well as claims 30, 31, 34 and 36 that depend from claim 29) are unpatentable based upon Grounds 1D and 2C of Bose’s ’025 Patent IPR, both of which relied on Davis. Appx196−199; Appx220−221.[8]

Transmission of Request to Server Connected to DAP. Claim 1 of the ’025 Patent recites that the processor of the headphone assembly, upon activation, initiates transmission of a request to the remote, network-connected server that is in communication with the DAP, which is in communication with the headphone assembly. Appx285. The Board found claim 1 (as well claims depending therefrom other than dependent Signal Strength claims) unpatentable. Appx162−173; Appx211−216.

Firmware Upgrade Claims. Several claims recite that the headphone assembly receives firmware upgrades from a remote server. Appx286−288, ’025

[8] Claims 32, 33, 35 and 37 also depend, directly or indirectly, from claim 29. Appx287. The Board found that Bose did not prove these claims are unpatentable because they are part of the Signal Strength claims. Appx222-224.

Patent, dependent claims 10, 38 and 51; Appx253–257, ’934 Patent, independent claim 1 and dependent claim 62 (which depends from claim 58). The Board found claims 10, 38 and 51 of the ’025 Patent, and claim 1 of the ’934 Patent, unpatentable. Appx190–194; Appx207–208; Appx25–36. The Board found that Bose did not prove that claim 62 of the ’934 Patent was unpatentable because it depends from claim 58, which the Board found that Bose did not prove unpatentable. Appx51–58; Appx72.

DSP Claims. Various dependent claims (i.e., claims 52 and 56) recite that the headphones comprise a processor with a digital signal processor (DSP) that “provides a sound quality enhancement for audio content” played by the earphones’ acoustic transducers. Appx256. Claim 56 recites that each of the earphones are wireless and comprises an earbud, i.e., TWS earbuds, whereas claim 52 is not so limited. Appx256, claims 52 and 56. The Board found these claims unpatentable. Appx40–46; Appx71; Appx84–89.

B. Apple as Petitioner

Apple filed three IPRs against each of the ’025 and ’934 Patents. Only one of the six petitions was granted as shown in the following table:

Patent	IPR Case No. for IPR filed by Apple
’025 Patent	IPR2021–00546 (not instituted) IPR2021–00626 (not instituted) IPR2022–00053 (not instituted)

Patent	IPR Case No. for IPR filed by Apple
’934 Patent	IPR2021−00592 (instituted) IPR2021−00692 (not instituted) IPR2022−00188 (not instituted)

The Board terminated the instituted IPR for ’934 Patent prior to issuance of a FWD. *Apple Inc. v. Koss Corp.*, IPR2021−00592, Paper 57 (PTAB Aug. 2, 2022).

III. DISTRICT COURT PROCEEDINGS

There are four pending litigations involving the ’025 and/or ’934 Patents: *Koss Corp. v. Bose Corp.*, No. 1:20−cv−12193 (D. Mass.); *Koss Corp. v. Skullcandy, Inc.*, No. 2:21–cv–00203 (D. Utah); *Koss Corp. v. Plantronics, Inc.*, No. 4:21–cv–03854 (N.D. Cal.); and *Koss Corp. v. PEAG LLC d/b/a JLab Audio*, No. 3:21–cv–01177 (S.D. Cal.). The *Bose*, *Skullcandy* and *JLab Audio* cases are presently stayed pending resolution of the appeals involving the IPRs of the asserted Koss patents. *Koss Corp. v. Bose Corp.*, No. 1:20−cv−12193, Dkt. 59 (D. Mass. Nov. 14, 2022); *Koss Corp. v. Skullcandy, Inc.*, No. 2:21–cv–00203. Dkt. 43 (D. Utah Jul. 21, 2021); *Koss Corp. v. PEAG LLC*, No. 3:21–cv–01177, Dkt. 52 (S.D. Cal. Nov. 22, 2022).

Koss asserted the ’025 and ’934 Patents against Apple in the United States District Court for the Western District of Texas. There, the district court construed some terms in the ’025 and ’934 Patents, Appx9683−9684, none of which were germane to Bose’s IPRs for the ’025 and ’934 Patents or this appeal. Prior to any

adjudication of the validity of any claims of the ’025 and ’934 Patents, Koss and Apple “resolved all matters in controversy between them,” such that the district court dismissed the case (*Koss Corp. v. Apple Inc.*, Case No. 6:20–cv–00665, Dkt. Nos. 303−304 (W.D. Tex. Jul. 23, 2022)) and the Board terminated the then-pending IPR for the ’934 Patent prior to issuance of a FWD. *Apple Inc. v. Koss Corp.*, IPR2021−00592, Paper 57 (PTAB Aug. 2, 2022).

SUMMARY OF ARGUMENT

I. The Board erroneously construed two claim terms in the ’025 Patent and the Board’s erroneous constructions led to incorrect decisions by the Board. ***First***, the Board misconstrued “body portion” in dependent claim 40, which led to the Board’s incorrect determination that Bose proved that claims 40−43, 46, 48 and 51 of the ’025 Patent are unpatentable under Bose’s asserted Grounds 1F (for claims 40−43, 46 and 48) and 1H (for claim 51). Appx206 (Ground 1F); Appx207−208 (Ground 1H). These claims recite the “elongated portion” form factor, such that the “body portion … sits at least partially in an ear of the user” and the elongated portion “extends from the body portion.” Appx288, claim 40. Based on the intrinsic evidence, this Court should construe “body portion” to mean “the main, central, or principal portion of the earphone.” Instead, the Board construed the term to mean merely “a portion or section of the earphone that forms a body.” Properly construed, claims 40−43, 46, 48 and 51 would not have been obvious under Grounds 1F and 1H because Davis’ earbud 46 is not the main, central, or principal portion of Davis’s headset.

Second, the Board misconstrued “extends from” in dependent claims 29 and 53 of the ’025 Patent, which led to the Board’s incorrect determination that claims 29−31, 34, 36 and 53 are unpatentable under Bose’s asserted Grounds 1D and 2C. Appx199 (Ground 1D); Appx220-221 (Ground 2C). These claims relate to the

"hanger bar" form factor, such that the "earphone ***extends from*** the body into the user's ear …." Appx287, claim 29; Appx288, claim 53. Based on the intrinsic evidence, this Court should construe the term to require a ***direct*** extension of the earphone from the body (i.e., to not preclude an indirect extension). Instead, the Board construed the term to encompass indirect extensions. Appx199. Under a proper construction of "extends from," claims 29–31, 34, 36 and 53 would not have been obvious under either Ground 1D or Ground 2C because Davis's earbud 46 does not extend directly from Davis's headset enclosure 12.

Ultimately claim construction is a question of law, such that this Court should review these two claim construction questions *de novo*. *Intel Corp. v. Qualcomm, Inc.*, 21 F.4th 801, 808 (Fed. Cir. 2021).

II. No substantial evidence supports the Board's finding that claims 56 and 57 of the '934 Patent are unpatentable under Bose's asserted Grounds 1A and 2C. These claims recite TWS earbuds, which receive firmware upgrades from a remote, network-connected server, and where the processor of each earbud comprises a DSP that provides a sound quality enhancement ("SQE") "for the audio content played by the acoustic transducer [i.e., speaker] of the earphone." Appx256, claim 56; Appx43. Such functionality in a small TWS earbud would normally require a relatively large battery, which would be relatively heavy in comparison to other headphone types and which would lead to the production of heat—two undesirable

qualities for a TWS earbud. Appx11313, ¶75. The '934 Patent enables a solution to this challenge by disclosing to use a space- and power-conserving SOC in the wireless earphones. Appx247, 6:43−48; Appx11316−11317, ¶¶81-82. The prior art relied upon by Bose, and credited by the Board, for Grounds 1A and 2C do not teach or suggest TWS earbuds, which receive firmware upgrades from a remote server, and where the processor of each earbud comprises a DSP that provides a SQE for audio played by the earphone. While it might have been known prior to the '934 Patent to employ DSPs in headsets to provide a SQE for audio output by the headset, that was typically for headsets with "earcups," which do not have the size constraints of TWS earbuds. Appx2620-2622, ¶58. And while it might have been known prior to the '934 Patent to employ a DSP in a TWS earphone for purposes other than providing a SQE for audio played back by the earphone, there is no substantial evidence that the subject matter of claim 56, as a whole, would have been obvious due to the size and power constraints for TWS earbuds.

ARGUMENT

I. STANDARD OF REVIEW

Claim construction is a question of law that this Court reviews *de novo*. *See Hamilton Beach Brands, Inc. v. f'real Foods, LLC*, 908 F.3d 1328, 1339 (Fed. Cir. 2018). Obviousness is a question of law based on underlying findings of fact. *Univ. of Strathclyde v. Clear-Vu Lighting LLC*, 17 F.4th 155, 160 (Fed. Cir. 2021). This Court reviews the Board's ultimate obviousness determination *de novo* and underlying factual findings for substantial evidence. *LG Elecs. Inc. v. Immervision, Inc.*, 39 F.4th 1364, 1371 (Fed. Cir. 2022).

Under a *de novo* standard of review, this Court gives no deference to legal conclusions of the Board. *Kamstrup A/S v. Axioma Metering UAB*, 43 F.4th 1374, 1380 (Fed. Cir. 2022) (legal conclusions reviewed *de novo*). For the Board's underlying factual findings on obviousness, substantial evidence requires "something less than the weight of the evidence but more than a mere scintilla of evidence," meaning that "[i]t is such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." *In re NuVasive, Inc.*, 842 F.3d 1376, 1379–80 (Fed. Cir. 2016) (internal quotation marks omitted).

The Board's application of its procedural rules is subject to review for abuse of discretion. *See Chamberlain Grp., Inc. v. One World Techs., Inc.*, 944 F.3d 919, 924 (Fed. Cir. 2019); *Ultratec, Inc. v. CaptionCall, LLC*, 872 F.3d 1267, 1271 (Fed.

Cir. 2017). "An abuse of discretion is found if the decision: (1) is clearly unreasonable, arbitrary, or fanciful; (2) is based on an erroneous conclusion of law; (3) rests on clearly erroneous fact finding; or (4) involves a record that contains no evidence on which the Board could rationally base its decision." *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367 (Fed. Cir. 2016).

This Court must reverse harmful errors by the Board. *In re Watts*, 354 F.3d 1362, 1369 (Fed. Cir. 2004). An error is harmful when it affects the decision below. *Id.*; *see also Munoz v. Strahm Farms, Inc.*, 69 F.3d 501, 504 (Fed. Cir. 1995) ("The correction of an error must yield a different result in order for that error to have been harmful and thus prejudice a substantial right of a party.")

II. THE BOARD COMMITTED NON-HARMLESS LEGAL ERROR IN DETERMINING THAT CLAIMS 40−43, 46, 48 AND 51 OF THE '025 PATENT ARE UNPATENTABLE

This Court should reverse the Board's finding that claims 40−43, 46, 48 and 51 of the '025 Patent are unpatentable under Ground 1F (for claims 40−43, 46 and 48) and Ground 1H (for claim 51) because (i) the Board's construction of "body portion" was wrong as a matter of law and (ii) the Board's error led to an incorrect decision for these claims under Grounds 1F and 1H, and because the Board rejected Bose's other asserted grounds for these claims, i.e., Ground 2A. Appx216−219.

Claim 40 of the '025 Patent is a dependent claim, depending from claim 1, that recites the "elongated portion" form factor. Claims 41−43, 46, 48 and 51

depend, directly or indirectly, from claim 40. In finding that Bose established that Grounds 1F and 1H rendered those claims unpatentable, the Board incorrectly construed "body portion" to mean "a portion or section of the earphone that forms a body." Appx159. Based on that erroneous construction, the Board found that Davis's earbud 46 constituted the claimed "body portion," with Davis's receiver enclosure 32 constituting the claimed "elongated portion that extend from the body portion." Appx204−205.

As explained below, if the Board had applied properly this Court's claim construction principles, the Board would have construed "body portion" to mean the "main, central, or principal portion of the earphone," which is not taught by Davis.

A. Legal Standard for Claim Construction and Standard of Review

The *Phillips* standard applies for construing the challenged claims in these IPRs. 37 C.F.R. § 42.100(b) (2020); *Palo Alto Networks, Inc. v. Finjan, Inc.*, 836 Fed. Appx. 916, 920 (Fed. Cir. 2020); Appx19. Under *Phillips*, claim terms are "given their ordinary and customary meaning," defined as "the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc).[9] The primary

[9] There are exceptions to this general rule. *Thorner v. Sony Comput. Ent. Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012) ("There are only two exceptions to this general rule: 1) when a patentee sets out a definition and acts as [a] lexicographer, or 2) when

source for the meaning of claim terms is the intrinsic evidence, which includes the claims themselves, the specification and the file histories. *Id.*, 1313–14, 1317. Extrinsic evidence, such as dictionaries or expert testimony, also can be considered "for a variety of purposes," such as "ensur[ing] that the court's understanding of the technical aspects of the patent is consistent with that of a person of skill in the art." *Id.*, 1318.

Ultimately claim construction is a question or law, which this Court reviews *de novo*. *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 801, 808 (Fed. Cir. 2021). This Court also reviews *de novo* intrinsic-evidence aspects of the claim construction analysis. *Id.* Underlying fact findings about extrinsic evidence, such as extra-patent usage, are reviewed for substantial evidence. *Id.* Here, although the Board reviewed extrinsic dictionary definitions of "body" in construing "body portion" (Appx155−158), those dictionary definitions were not disputed and the Board's claim construction reasoning turned on intrinsic evidence only, such that the Board's construction of "body portion" (as well as "extends from" as described in Section III below) should be reviewed *de novo*. *See Intel*, 21 F.4th at 808.

the patentee disavows the full scope of a claim term either in the specification or during prosecution."). Those exceptions do not apply here.

B. <u>"Body Portion" Should Be Construed to Mean the Main, Central, or Principal Portion of the Earphone</u>

Based on the '025 Patent's intrinsic evidence, particularly the claims themselves and the specification, the Board should have construed "body portion" in claim 40 to mean the main, central, or principal portion of the earphone. Starting with the claims themselves, claim 40 recites that each earphone comprises two portions—the "body portion" and the "elongated portion." Consistent with this Court's precedents, because the language of claim 40 specifically identifies two different portions of the earphone, the two portions must be construed as different and not one in the same. Appx157 (Board stating that the two portions are "separate" in claim 40); *see also Becton, Dickinson and Co. v. Tyco Healthcare Group, LP*, 616 F.3d 1249, 1254 (Fed. Cir. 2010) ("clear implication" of listing claim elements separately is that those elements are distinct components) (quoting *Gaus v. Conair Corp.*, 363 F.3d 1284, 1288 (Fed. Cir. 2004)); *Engel Indus., Inc. v. Lockformer Co.*, 96 F.3d 1398, 1404–05 (Fed. Cir. 1996) (where a claim provides for two separate elements, a "second portion" and a "return portion," these two elements "logically cannot be one and the same").

Koss's use of different modifiers for the two portions—"body" and "elongated"—further confirm that the body portion and elongated portion must be different parts of the earphone. The body portion is the body of the earphone and the elongated portion is not the body portion. The ordinary meaning of "body" is

"the main, central, or principal part" (Appx21713), which is consistent with how the '025 Patent specification describes the "body" of the earphone, and consistent with how a POSA would understand the term "body" in the '025 Patent. Appx20319–20320, ¶60. According to the '025 Patent, the body 12 comprises the component from which sound emanates, i.e., the ear canal portion 14; the component with which the user can interact to control operation of the earphone, i.e., the exterior portion 15; and the key circuitry in the form of the transceiver circuit 100 (Appx278, 3:15–37), thereby making it the main, central or principal portion of the earphone.

The elongated portion is, in contrast, "elongated," which means long, slender, rod-like, stretched out, or longer than wide. *See Cozy, Inc. v. Dorel Juvenile Group, Inc.*, -- F. Supp. 3d --, 2022 WL 16838666, *17 (Fed. Cir. Nov. 9, 2022) ("Common definitions of 'elongate' are 'to extend the length of,' 'to grow in length,' 'stretched out' or 'being much greater in length than in width,'" citing Merriam-Webster.com Dictionary); *Robinson v. Advanced Decoy Research, Inc.*, 519 F. Supp. 2d 1087, 1096 (S.D. Cal. 2007) ("long, slender rod-like structure"); *Floe Int'l, Inc. v. Newmans' Mfg. Inc.*, Case No. 04–cv–5120, 2006 WL 1716281, *11 (D. Minn. June 21, 2006) ("stretched out, extended, or lengthened"); *Fitness Quest Inc. v. Monti*, Case No. 06–cv–02691, 2007 WL 2359821, *2–3 (N.D. Ohio Aug. 16, 2007) ("longer than it is wide").

The claim language also clarifies that the body portion "sits at least partially

in an ear of the user," whereas the elongated portion "extends from the body portion." The fact that a "stretched out" (or elongated) portion "extends from" the part that sits at least partially in the ear connotes that the "stretched out" portion is not the main or central portion of the earphone.

The ’025 Patent's specification discloses several wireless earphone embodiments, one of which—at Figure 1B (Appx261) — exactly matches the earphone form factor recited in claim 40. The ’025 Patent's specification does not expressly use the term "body portion," but it uses the term "body," teaching intrinsically that the body comprises, with respect to Figures 1A and 1B, the ear canal portion 14 and the exterior portion 15. Appx278, 3:16−20 ("The body 12 may comprise an ear canal portion 14 that is inserted in the ear canal of the user of the earphone 10" and "the body 12 also may comprise an exterior portion 15 that is not inserted into user's ear canal."); *see also* Appx19293, ll.11−17. With reference to the annotated Figure 1B of the ’025 Patent below (*see* Appx158 (citing Appx12222)), the elongated portion extends from the body portion that sits at least partially in the user's ear and is made up of, collectively, the ear canal portion 14 (which sits at least partially in the user's ear) and the exterior portion 15.

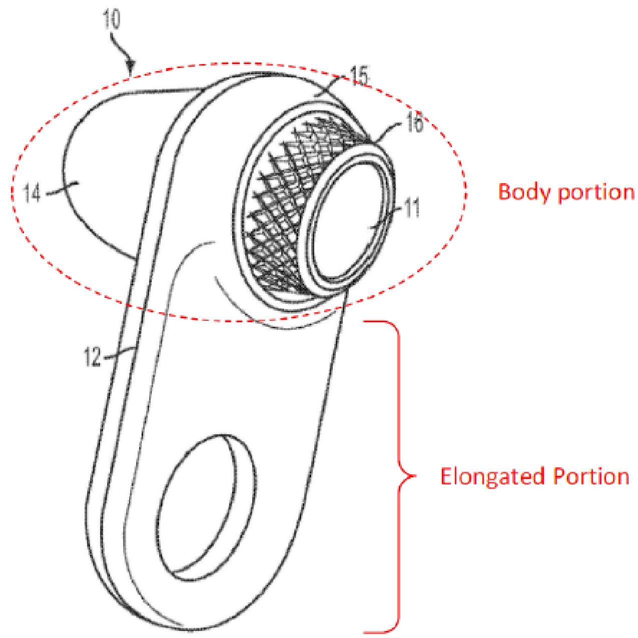

FIG. 1B

The Figure 1B wireless earphone is also distinct from the Figure 1A embodiment, which does not have such an elongated portion. Appx261. Thus, the Figure 1B embodiment shows a "body" portion that is the main, central, or principal portion of the earphone and which is different from the "elongate" portion that extends from the body portion.

Three other disclosures in the '025 Patent reinforce that the "body" portion 12 is the main, central, or principle portion of the earphone.

First, the ear canal portion 14 and the exterior portion 15, which collectively make up the "body 12" according to the '025 Patent, are the main, central and principle portions of the earphone because the sound emanates from the ear canal portion 14 and the user interacts with the exterior portion 15 to control the earphone.

Id., 3:20−23 ("The exterior portion 15 may comprise a knob 16 or some other user control (such as a dial, a pressure-activated switch, lever, etc.) for adjusting the shape of the ear canal portion 14."). Those are the main operative parts of the earphone, and the '025 Patent does not ascribe any functionality to the elongated portion in Figure 1B.

Second, in a related manner, the Figure 1A earphone 10 of the '025 Patent only comprises the ear canal portion 14 and the exterior portion 15. Appx261. The fact that there is an embodiment in the '025 Patent that only includes these two components, which make up the "body 12" according to the specification, proves that the combination of the ear canal portion and the exterior portion constitute the main, central, or principal portion of the earphone. In other words, any other components are ancillary to the main components needed for the wireless earphone that are provided by the ear canal portion and the exterior portion.

Third, the intrinsic evidence teaches that the transceiver circuit 100, which comprises, among other things, the processor 114, the wireless communication circuit 110, and the memories 120−122, is "housed in" the body 12, i.e., in "the exterior portion 15 of the earphone 10 and/or in the ear canal portion 14." Appx278, 3:35−37; *id.*, 3:16−18 (body comprises ear canal portion and exterior portion); Appx268, Fig. 3 (block diagram of transceiver circuit); Appx279−280, 6:26−7:56 (describing components of transceiver circuit); Appx19293, ll.11−17 (body includes

both ear canal portion and exterior portion). The transceiver circuit provides the wireless functionalities for the wireless earphones described in the ’025 Patent (Appx277, 1:66−2:2; Appx278, 3:32−35; Appx280, 7:18−47; Appx281, 10:46−51), and the fact that it is housed in the body reinforces that the body portion (as opposed to the elongated portion or any other portion of the earphone) is the main, central, or principle portion of the earphone. It houses the circuity that performs the core wireless functionalities of the wireless earphone.

The file history of the ’025 Patent does not elucidate further on the meaning of “body portion” (Appx12887−12903; Appx12972−12992; Appx13003−13009), and neither the parties nor the Board below asserted that it did. However, the extrinsic dictionary meaning of “body,” which is “the main, central, or principle part” (Appx21713), ensures that Koss’s intrinsically based construction is consistent with how a POSA would understand the term. Appx20319−20320, ¶60; *see also Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1584 n. 6 (Fed.Cir.1996) (“Dictionaries ... are often useful to assist in understanding the commonly understood meaning of words.”); *Free Motion Fitness, Inc. v. Cybex Int’l, Inc.*, 423 F.3d 1343, 1348−49 (Fed. Cir. 2005) (dictionaries can help “determine the most appropriate definition”); *TEK Global, S.R.L. v. Sealant Sys. Int’l, Inc.*, 920 F.3d 777, 786 (Fed. Cir. 2019) (using dictionary definition to support conclusion drawn from intrinsic evidence).

Therefore, the legally relevant claim construction evidence demonstrates that "body portion" in claim 40 should be construed to mean "the main, central, or principle portion of the earphone."

C. The Board Erroneously Evaluated the Intrinsic Evidence

The Board erroneously construed "body portion" to mean "a portion or section of the earphone that forms a body." Appx159. This Court should reserve the Board's erroneous construction because the Board misconstrued the intrinsic evidence and relied on illogical reasoning.

1. The Board Misconstrued the Intrinsic Evidence

The Board misconstrued the intrinsic evidence in several respects, which led to its erroneous claim construction.

First, the Board asserted, in a footnote, that "it is reasonable to correlate ear canal portion 14 [of the '025 Patent] to the claimed 'body portion' and exterior portion 15…to the claimed 'elongated portion.'" Appx159, n.21. That, in fact, is unreasonable in light of the intrinsic evidence that explicitly correlates the body 12 to both the ear canal portion 14 and the exterior portion 15: "The body 12 may comprise an ear canal portion 14 that is inserted in the ear canal of the user of the earphone 10" and "the body 12 also may comprise an exterior portion 15 that is not inserted into user's ear canal." Appx278, 3:16–20. The Board acknowledged that claim 40 requires the body and elongated portions to be "distinct." Appx158. Given

that observation, it was unreasonable for the Board to then conclude that the exterior portion 15, which the ’025 Patent teaches is part of the body, is not correlated to the body portion but instead is correlated to the distinct elongated portion.

Second, in rejecting Koss’s proposed construction, the Board reasoned that the body 12, which the ’025 Patent describes as comprising both the ear canal portion 14 and the exterior portion 15, cannot form the main, central, or principal part of earphone 10 because, according to the Board, the body 12 “makes up the entirety of earphone 10.” Appx157. That statement is only true for the Figure 1A embodiment of the ’025 Patent but ignores that the statement is not true for the Figure 1B embodiment on which claim 40 reads. The ’025 Patent intrinsically discloses several earphone form factors that, unlike the embodiment of Figure 1A, have many other components than merely the body 12, such as the Figure 1B embodiment, which includes the elongated portion that extends downwardly from the portion of the earphone (i.e., body 12) that comprises the ear canal portion 14 and the exterior portion 15. Appx264. The ear canal portion 14 and the exterior portion 15 do not comprise the entirety of the earphone 10 in Figure 1B.

Other wireless earphone form factors in the ’025 Patent also prove that the body does not necessarily make up the entirety of the earphone as the Board concluded. For example, the hanger bar form factor embodiment disclosed at Figures 1D and 1E demonstrates the error in the Board’s analysis. In this

embodiment, the earphone includes the hanger bar 17 in addition to the body 12. Appx263; Appx278, 3:66–4:20. Thus, the intrinsic evidence contradicts the Board's rationale that allegedly the body 12 "make[s] up the entirety of earphone 10." Appx157.

Third, the language of claim 40, which shows that the elongated portion is different from the body portion, establishes that the Board's construction was flawed. Appx288, claim 40; Appx159 (Board stating that "claim 40 requires that the 'body portion' and 'elongated portion' are two distinct portions of each earphone"). The Board rejected that body 12 in the patent's figures corresponds to the claimed "body portion" because "body 12, which comprises both ear canal portion 14 and exterior portion 15, cannot correspond to the claimed 'body portion' because claim 40 also recites a separate 'elongated portion.'" Appx157. The reasoning is not consistent with the intrinsic evidence, which clearly equates the portion of the earphone that is the "body 12" with the ear canal portion 14 and the exterior portion 15 in both Figures 1A and 1B. Appx278, 3:15–18. The intrinsic evidence also shows that the wireless earphone can comprise components different from the body, such as the elongated portion in Figure 1B and the hanger bar in Figures 1D and 1E. Appx261; Appx263. To that end, some claims of the '025 Patent, particularly dependent claim 54, are limited to the Figure 1A embodiment, which recites that the "earphones comprise earbuds" (Appx288), whereas other

claims, like claim 40, recite additional, different components. Different claims of a patent can read on different embodiments. *See PPV Broadband, Inc. v. Corning Optical Commc'ns RF, LLC*, 815 F.3d 747, 755 (Fed. Cir. 2016) (rejecting proposition that "each and every claim ought to be interpreted to cover each and every embodiment"); *Baran v. Med. Device Techs., Inc.*, 616 F.3d 1309, 1316 (Fed. Cir. 2010) ("It is not necessary that each claim read on every embodiment."). To that end, claim 40 does not read on the Figure 1A embodiment because claim 40 recites the "elongated portion" that is not shown in Figure 1A. Consistent with this intrinsic evidence, however, the "body portion" of claim 40 precisely corresponds to the combination of the ear canal portion and the exterior portion, and the "elongated portion" corresponds to the different portion that extends downwardly from the portion (i.e., the "body") comprising the ear canal portion and the exterior portion, which is the exact opposite of the Board's interpretation of the intrinsic evidence.

***Finally*,** the Board dismissed Koss's identification of the claimed "body portion" and "elongated portion" because annotated Figure 1B (reproduced above), allegedly, "identifies a 'body portion' that does not correspond to body 12 as a whole." Appx157−158. This conclusion, however, hyper-technically relies on the precise placement of the reference numeral "12" and the dashed oval labeled as the "body portion" in the annotated diagram. *See* Appx158. Had the oval been

incrementally larger and/or lowered to include the reference numeral "12" in Figure 1B, the Board's observation would be rendered moot. Moreover, the Board's observation is contradicted by the intrinsic evidence that repeatedly teaches that the earphone can comprise more components than merely the ear canal portion and the exterior portion, i.e., the body (Appx278, 3:16–20), such as described above in connection with the form factors shown in Figures 1B, 1D and 1E.

2. <u>The Board's Reasoning Was Illogical</u>

The Board reasoned that because "claim 40 requires that the 'body portion' and 'elongated portion' are two distinct portions of each earphone, we construe 'body portion' as 'a portion or section of the earphone that forms a body.'" Appx159. The Board, therefore, essentially and unhelpfully only rearranged the words of the claim term for its construction without construing "body." *See Wi-Lan, Inc. v. Acer, Inc.*, 717 F. Supp. 2d 549, 574 (E.D. Tex. 2010) (construction that merely rearranged the words of term to be construed is not "particularly helpful"); *Cheetah Omni LLC v. Alcatel-Lucent Inc.*, 939 F. Supp. 2d 649, 666 (E.D. Tex. 2013) (rejecting a construction that merely rearranged the words of the term).

It does not logically follow that because the body portion and elongated portion are two distinct portions of each earphone, the "body portion" should be circularly defined as "a portion or section of the earphone that forms a body." The Board's construction ignores the recited relationship in claim 40 for the two

portions—one of which is a "body" and another of which is "elongated." The Board afforded more weight to the noun "portion" than to the modifier "body" because the Board's construction includes the word "body" itself without importing any meaning to it. Thus, the Board did not endeavor to recognize the difference between one portion of the earphone being the "body" and another portion being "elongated."

For these reasons, the Board erred in evaluating the relevant claim construction evidence, which resulted in a legally erroneous construction of "body portion."

D. <u>The Board Erroneous Construction was Non-Harmless</u>

The Board did not find in Bose's favor for claims 40−43, 46, 48 and 51 on its second ground, Ground 2A, for these claims. Appx216−219. The Board found in Bose's favor for claims 40−43, 46, 48 and 51 only on Grounds 1F and 1H, and the Board predicated that determination on its erroneous construction of "body portion." Appx200−208. When the legally proper construction of "body portion" is applied, it is clear that claims 40−43, 46, 48 and 51 would not have been obvious under Grounds 1F and 1H. Thus, the erroneous claim construction was non-harmless, and this Court should reverse the invalidation of claims 40−43, 46, 48 and 51.

Having construed "body portion" to mean "a portion or section of the earphone that forms a body," the Board concluded that "Davis's earbud 46 satisfies the claimed 'body portion that sits at least partially in an ear of the user when the

headphone assembly is worn by the user.'" Appx204. The Board also found that Davis's receiver enclosure 32 satisfies the "elongated portion" element of claim 40. Appx205. However, there is no evidence that Davis's earbud 46 constitutes the main, central, or principal portion of the earphone, which is the proper construction of "body portion" in claim 40 for the reasons described above. To the contrary, the evidence establishes that a POSA would not consider Davis's earbud 46 to be the main, central or principal portion of the earphone.

While Davis's earbud 46 is inserted into the ear of the user, it is made of "soft rubber" or "foam." Appx14275, 6:33−43. It also is even detachable from the receiver enclosure. *Id.* There is no evidence that it houses any circuitry like the body of the '025 Patent, and it is small compared to the other, bulkier components of Davis's headset, such as the headset enclosure 12, the receiver enclosure 32, and the arcuate earhook 13. Appx14264−14267, Figs. 1 to 3B; Appx14269−14270, Figs. 7−8. For those reasons, as Koss's expert McAlexander testified, a POSA would not consider Davis's detachable, small, soft rubber earbud 46 to be the main or central portion of the earphone merely because it rests against the opening of the user's ear canal (Appx20319−20320, ¶60) and Bose presented no evidence to the contrary. Appx9209− 9241. The Board never addressed the question of whether Davis's earbud is the main, central, or principal portion of Davis's headset because of the Board adopted the incorrect construction of "body portion" as described above.

Therefore, this Court should adopt Koss's proposed construction for "body portion" in claim 40 and reverse the Board's determination that claims 40−43, 46, 48 and 51 are unpatentable.

III. THE BOARD COMMITTED NON-HARMLESS LEGAL ERROR IN DETERMINING THAT CLAIMS 29−31, 34, 36 AND 53 OF THE '025 PATENT ARE UNPATENTABLE

This Court should reverse the Board's finding that claims 29−31, 34, 36 and 53 of the '025 Patent are unpatentable because (i) the Board's construction of "extends from" in claims 29 and 53 was wrong as a matter of law and (ii) the Board's error adversely affected its determination that claims 29−31, 34, 36 and 53 are unpatentable.

Claims 29 and 53 depend directly or indirectly, as the case may be, from claim 1 and recite the "hanger bar" form factor. In finding that Bose established that Grounds 1D and 2C rendered those claims unpatentable, the Board incorrectly construed "extends from" to encompass indirect extensions, i.e., that the earphone can extend indirectly from the body. Appx199. Based on that erroneous construction, the Board found that Davis's earbud 46 "extends from" Davis's headset enclosure 12 even though the two components are not connected directly. Appx196−199.

As explained below, if the Board had applied properly this Court's claim construction principles, the Board would have construed "extends from" to preclude

indirect extensions (or to require a direct extension), which is not taught by Davis.

A. The Board's Findings for Claims 29 and 53 of the '025 Patent

Claims 29 and 53 recite that each earphone comprises "an adjustable curved hanger bar" and "a body connected to the hanger bar, wherein the earphone ***extends from*** the body into the user's ear when the headphone assembly is worn by the user." Appx287−288 (emphasis added). The Board concluded that these claims (as well as claims 30, 31, 34 and 36) are unpatentable under Bose's Grounds 1D and 2C. Appx196−199 (Ground 1D); Appx220−221 (Ground 2C). In finding for Bose on Grounds 1D and 2C, the Board relied extensively upon the Davis reference, specifically Figures 1 and 2 thereof, reproduced again below (*see* Appx14264−14265), which the Board concluded showed the claimed "body" as Davis's headset enclosure 12; the claimed "hanger bar" as Davis's earhook 13; and the claimed "earphone" as Davis's earbud 46. Appx196 (citing Appx11753, Appx11756).[10]

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[10] The Board explained its rationale with respect to Davis only in connection with Ground 1D. Appx196-199. For Ground 2C, Bose "relie[d] on the teachings of Davis in the same manner as the teachings were relied on in Ground 1D," and the Board referred to its findings for Ground 1D to find the claims obvious under Ground 2C. Appx220-221.

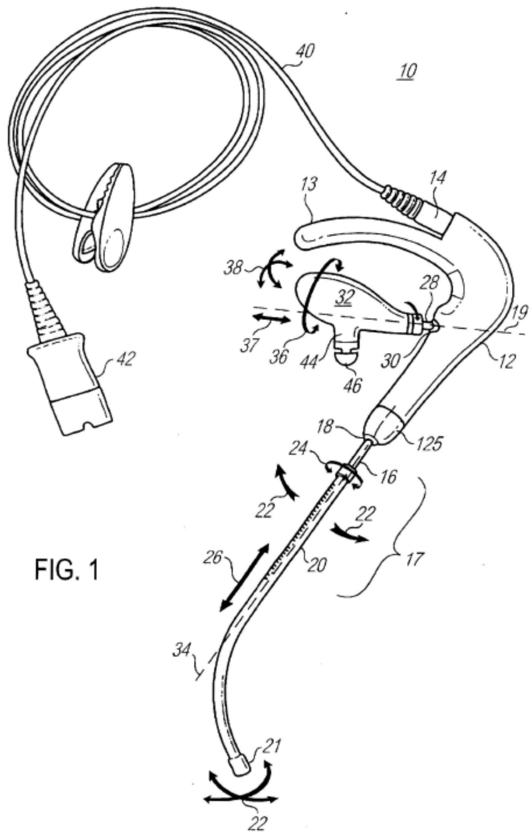

FIG. 1

Fig. 1 of Davis

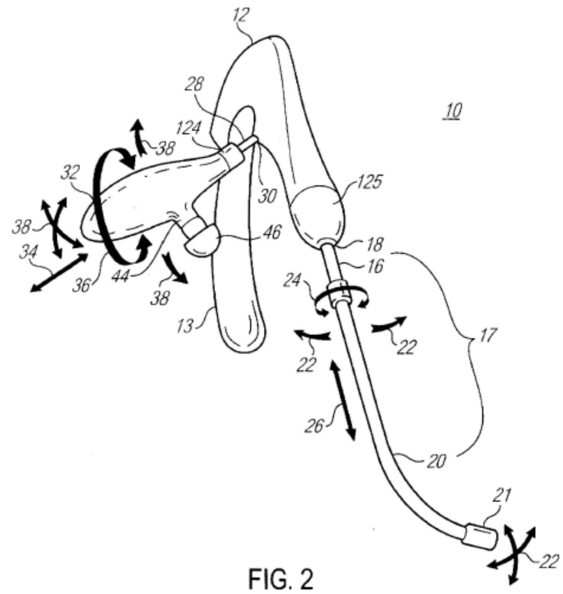

FIG. 2

Fig. 2 of Davis

As the above figures plainly show, Davis's earbud 46 is not directly connected to, and does not extend directly from, Davis's headset enclosure 12. Instead, the earbud 46 is connected to a "receiver enclosure 32" that is connected to the headset enclosure 12 via a ball tube 29 and socket 30. Appx14274, 4:49−5:6; Appx14275, 6:32−36Appx20318, ¶59.

In finding for Bose, the Board incorrectly construed "extends from" in claims 29 and 53 to mean "that the earphone … can extend ***indirectly*** from the body …" based upon Figures 1D and 1E of the '025 Patent. Appx199 (emphasis added). Those figures show earphones with a "dual element" speaker, where one speaker

106−A is inserted into the user's "cavum concha" and the other speaker 106−B is not.[11] Appx278, 4:5−20. According to the Board, claims 29 and 53 "require the 'earphone' (not an individual speaker) to extend into the user's ear," and because Figures 1D−1E show only one of the speakers inserted into the ear, the claims do not require a direct extension of the earphone from the body. Appx199 (parenthetical in original). Thus, the Board disregarded and did not address the fact that Davis only teaches the indirect connection/extension of the alleged earphone (i.e., earbud 46) to/from the alleged body (i.e., receiver enclosure 32).

B. Claims 29 and 53 Should Be Construed to Require the Earphone to Extend Directly from the Claimed "Body"

Because the Board's construction of "extends from" was not based on underlying fact findings about extrinsic evidence, the Court reviews the Board's construction *de novo*. *See Intel*, *supra*, 21 F.4th at 808. The Court should reverse the Board's construction for the following four reasons.

First, focusing on the claim language as *Phillips* teaches (*Phillips, supra*, 315 F.3d at 314), claims 29 and 53 recite that "the earphone extends from the body …." Claims 29 and 53 also depend (directly or indirectly) from independent claim 1, which recites that each earphone "comprises an acoustic transducer," i.e., a speaker. Appx285, 18:8. In this context, the indefinite article "an" means "at least

[11] The evidence is that the "concha" is the bowl-shaped depression of the pinna of the ear. Appx13388, ¶61; Appx20372, ¶16.

one," i.e., the earphone comprises at least one acoustic transducer. *KCJ Corp. v. Kinetic Concepts, Inc.*, 223 F.3d 1351, 1356 (Fed. Cir. 2000); *see also Convolve, Inc. v. Compaq Computer Corp.*, 812 F.3d 1313, 1321 (Fed. Cir. 2016) ("a" means "one or more"). Accordingly, the dual element speaker shown in Figures 1D and 1E are an example of "an acoustic transducer" as recited in claim 1.

Second, although the '025 Patent's specification does not use the term "extend" or "extends from," it does show, at Figures 1D and 1E (reproduced below; *see* Appx263), an earphone with a "dual element" speaker and with a curved hanger bar. Appx278, 4:2−20. The duel element speaker consists of the speaker element 106−A that is inserted into the cavum concha of the user's ear and the speaker element 106−B that is not inserted into the cavum concha. *Id.* This disclosure maps to claims 29 and 53. Each earphone comprises (i) a curved hanger bar 17 and (ii) a body 12 connected to the curved hanger bar, with (iii) "at least one" acoustic transducer, consisting of the single dual element speaker consisting of speaker elements 106−A and 106−B, that is (iv) directly connected to, and directly extending from, the body and (v) inserted into the user's ear. Appx278, 4:2−8. The '025 Patent discloses, consistently with claims 29 and 53, that the dual element speaker is ***directly*** connected to, and ***directly*** extends from, the body and that the dual element speaker is inserted into the user's ear. No other components are is connected between the body and the dual element speaker; instead, they are connected to each

other directly such that the dual element speaker extends directly from the body. Appx263.

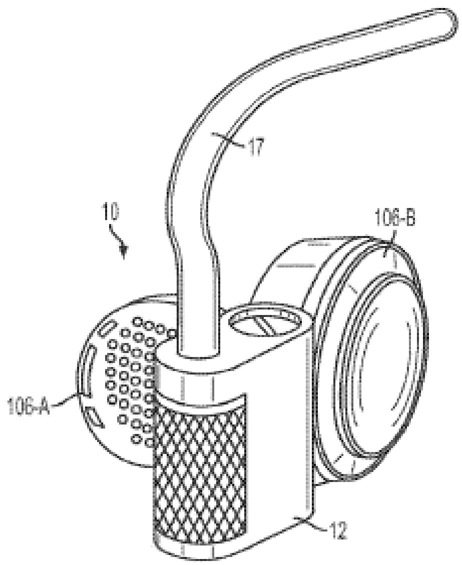

FIG. 1D

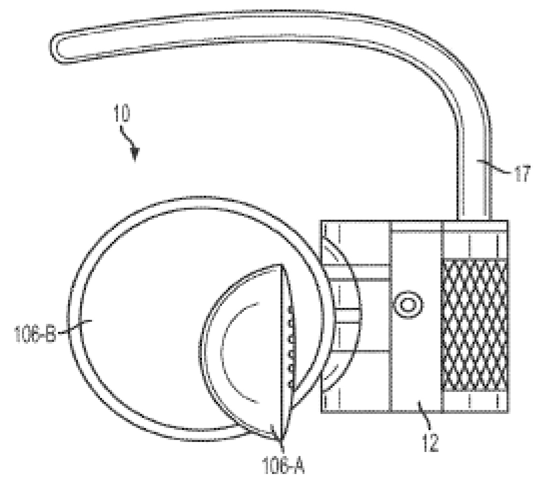

FIG. 1E

Third, there is no requirement in claims 29 and 53, or in the specification, that the ***entirety*** of the earphone must be inserted into the user's ear. Instead, these claims merely recite that the earphone "extends … into" the ear. To require that the entirety of the earphone be inserted into the user's ear requires importing the word "entirely" into the claims before the word "into," which is improper. *Seachange Int'l, Inc. v. C-COR, Inc.*, 413 F.3d 1361, 1376 (Fed. Cir. 2005) ("it is improper to import a limitation into a claim where the limitation has no basis in the intrinsic record").[12]

[12] The file history of the '025 Patent does not inform the meaning of "extends from" in claims 29 and 53, which were claims 30 and 54 in the application. Appx12887-

Yet, that is exactly what the Board did.

The Board rejected Koss's proposed construction that requires a direct extension because, according to the Board, Koss's premise would require both speakers 106−A and 106−B to be inserted into the user's ear, whereas, according to the Board, the intrinsic evidence only discloses the speaker 106−A being inserted into the ear. Appx199. The Board is correct that the speaker 106−A is inserted into the ear and that the speaker 106−B is not, but the speakers 106−A and 106−B comprise a single, "dual element" speaker according to the specification. Appx278, 4:18 (referring to the speakers as a "dual element"). The dual element speaker extends ***directly*** from the body and is inserted into the user's ear. *Id.*, 4:2−9. Indeed, this is the only hanger bar embodiment disclosed in the '025 Patent. Appx197 ("… Petitioner points to Figures 1D−1E of the '025 Patent, which Petitioner asserts depict the only hanger-bar embodiment of the '025 Patent.").

Fourth, the ordinary meaning of "extends from" signifies extending ***directly*** from. In *Duhn Oil Tool, Inc. v. Cooper Cameron Corp.*, 474 F. Supp. 2d 1148, 1163−64 (E.D. Cal. 2007), the district court construed "extending from" to mean "to 'protrude' from a 'starting point.'" In the '025 Patent, the dual element speaker protrudes from a starting point that is the body. *See also Panduit Corp. v.*

12903; Appx12972-12992; Appx13003-13009.

HellermanTyton Corp., Case No. 03−cv−8100, 2004 WL 1899381, *1 (N.D. Ill. Aug. 10, 2004) (construing "extending laterally from" to require an integrated, and thereby direct, extension). Similarly, in both *Mahurkar v. Arrow Int'l, Inc.*, 160 F. Supp. 2d 927, 937−38 (N.D. Ill. 2001) and *EZ Dock, Inc. v. Schafer Sys., Inc.*, Case No. 98−2364, 2003 WL 163718, *6 (D. Minn., Jan. 22, 2003), district courts construed "extending between" to mean "stretching from," which connotes a direct extension. Likewise, in Figures 1D and 1E, the dual element speaker stretches directly from the body.

Thus, consistent with the ordinary meaning of "extends from," the intrinsic evidence of the '025 Patent shows that the earphone, which comprises the acoustic speaker according to claim 1, extends directly from the body (which is connected to the curved hanger bar in claims 29 and 53). Thus, "extends from" in claims 29 and 53 should be construed, as a matter of law, to require a ***direct*** extension of the earphone from the body. In other words, this Court should construe "extends from" to exclude an indirect extension, in contrast to the construction urged by Bose and adopted by the Board. Appx197−199.

C. <u>Claims 29 and 53 Would Not Have Been Obvious Under a Legally Proper Construction of "Extends From"</u>

When claims 29 and 53 are construed properly to exclude indirect extensions, it is clear that Bose failed to show that claims 29 and 53 would have been obvious under its asserted Grounds 1D and 2C. For both grounds, Bose relied "on Davis as

disclosing in-the-ear type earphones having an arcuate ear hook or hanger bar 13." Appx196 (citing Appx11752−11753 (Petition); Appx14263−14277 (Davis); Appx13440−13444 (Casali Dec.), ¶¶152−155). Bose argued that Davis's headset enclosure 12 corresponded to the claimed "body" of claims 29 and 53; that Davis's earhook 13 corresponded to the claimed "hanger bar"; and that Davis's earbud 46 corresponded to the claimed "earphone." Appx196 (citing Appx11756 (Petition)). In Davis, however, particularly as shown in Figures 1 and 2 thereof, reproduced above, Davis's earbud 46 does not directly extend from Davis's headset enclosure 12. Instead, the earbud 46 is connected indirectly to the headset enclosure 12 via an angularly-adjustable receiver enclosure 32. Appx14264−14265; Appx14274, 4:45−63; Appx14275, 6:32−37; Appx20318−20319 (McAlexander Dec.), ¶59; Appx20373−20377 (Blair Dec.), ¶¶17−21.

There is no evidence in the record showing that Davis's earbud 46 directly extends from Davis's headset enclosure 12, or that claims 29 and 53 would have been obvious under a legally proper construction of claims 29 and 53 that requires the earphone to extend directly from the body. Therefore, the Board's erroneous construction was non-harmless, as it led to the erroneous conclusion by the Board that Bose proved claims 29 and 53 are unpatentable. Appx199; Appx221. Accordingly, this Court should reverse the Board's finding that claims 29 and 53 (as well as claims 30, 31, 34 and 36, which depend from claim 29) are unpatentable.

See e.g., Blue Calypso, LLC v. Groupon, Inc., 815 F.3d 1331, 1347 (Fed. Cir. 2016) (reversing unpatentability determination by Board due to an error by Board).

IV. NO SUBSTANTIAL EVIDENCE SUPPORTS THE BOARD'S DETERMINATION THAT CLAIMS 56 AND 57 OF THE '934 PATENT ARE UNPATENTABLE

A. Scope of Claims 56 and 57

Based on the incorporated claims elements from which it depends, the Board agreed that claim 56 of the '934 Patent (which depends from claims 1, 54 and 55) effectively recites TWS earbuds with a DSP that provides the SQE for audio content played by the earphones and that can receive firmware upgrades. Appx43 (Board stating that "essentially, claim 56 includes TWS earbuds wherein each earbud includes the circuitry … including a DSP for providing a 'sound quality enhancement'…"). Such functionality in a TWS earbud, according to McAlexander, would normally "require a relatively larger battery" that would "lead[] to the production of heat," which would be undesirable for a TWS earbud positioned within the user's ear. Appx11313, ¶75.

That is why prior to the '934 Patent, headphones with DSPs that provided a SQE were typically only implemented in over-the-ear headphones that had earcups that were large enough to support the size and weight of the power source. Appx11313−11314 (McAlexander Dec.), ¶76; Appx2620−2622 (Casali Dec.), ¶58. The '934 Patent provides a solution to that challenge by using a SOC for the

transceiver circuit, "which is conducive to miniaturizing the components of the earphone 10, which is advantageous if the earphone 10 is to be relatively small in size, such as an in-ear earphone" as shown in Figures 1A and 1B of the '934 Patent. Appx247, 6:43−48; Appx11316−11317, ¶¶81−82.

Claim 57 depends from claim 56, and recites that the processors of the earphones further comprise baseband processors. Appx256. Koss does not challenge the invalidation of claim 57 by the Board separately from the Board's erroneous invalidation of claim 56.

B. The Board Found Claim 56 Unpatentable Under Both Grounds 1A and 2C

The Board found that Bose proved that claim 56 would have been obvious under both Grounds 1A and 2C asserted by Bose. In Ground 1A, Bose relied upon the Schrager and Goldstein references. With regard to Schrager, it is undisputed that Schrager discloses a headset, with two earpiece portions, and with a DSP. Appx18503, 5:2−14, 5:54−58; Appx180504, 7:21−23. It also is undisputed that Schrager does not disclose TWS earbuds. Appx11288−11289, ¶39; Appx7707−7720. The parties did dispute whether Schrager's DSP provides a SQE for audio played back by the earphones. Although Bose initially asserted that the digital-to-analog (D/A) conversion performed by Schrager's DSP constituted a SQE (Appx822; Appx831; Appx2381−2382, ¶189), Bose later changed course, informing the Board that it need not "address this argument." Appx1246.

Instead Bose relied upon Goldstein, which discloses an earpiece with a DSP and "a method for acoustically compensating for the non-linear frequency response characteristics of the Acoustical Isolation Cushions of a given Headphone system by applying corresponding inverse filters to the Environmental Audio input signal at the DSP." Appx13897, ¶[0090]. The Board found that Goldstein discloses a DSP that provides a SQE and that DSPs for SQEs were well known prior to the '934 Patent. Appx44−46. Based on the teachings of Schrager, the interpretation of Goldstein, and the testimony of Williams and Casali, the Board found that claim 56 would have been obvious under Ground 1A. Appx42−46.

In Ground 2C for claim 56, Bose relied on Rezvani-446, Rezvani-875, Oh and Hind. Appx8; Appx794. Of these, only Rezvani-875 and Oh disclose a headset or earphone with a DSP; however, the disclosed DSPs do not perform a SQE for audio played back by the earphones. Rezvani-875 discloses a DSP for speech recognition. Appx13736, ¶¶[0022]−[0023]. Oh discloses a pair of earbuds where each could include "an echo eliminating circuit using" a DSP. Appx18466, ¶[44]. The echo eliminating circuit is used for "an audio signal transmitted to a person on the other end of the communication line …." *Id.*, ¶[43]. Based on the disclosure of Rezvani-875 and Oh, as well as the testimony of Williams and Casali, the Board found that claim 56 would have been obvious under Ground 2C. Appx84−89.

C. No Substantial Evidence Supports the Board's Determinations that Claim 56 is Unpatentable

1. Ground 1A

The Court should reverse the Board's determination that Claim 56 is unpatentable because there is no substantial evidence to support the Board's finding that Schrager and Goldstein render claim 56 obvious. Specifically, the Board did not have substantial evidence to conclude, as it did, that "POSAs would have implemented Schrager-Goldstein's earbuds such that each uses Schrager's DSPs to 'enhance playback sound quality such as noise cancellation and/or equalization because such functionality was conventional and desirable.'" Appx44−45 (quoting Appx1246). The record establishes that neither reference discloses a DSP in a TWS earbud that provides a SQE for audio played by the speaker, and Koss' evidence established the technical reasons why it would not have been obvious to use a DSP in a TWS earbud that (i) receives firmware upgrades from a remote server and (ii) provides a SQE for audio played by the speaker.[13] Appx11312−11314, ¶¶74−76; Appx11316−11317, ¶¶81−82.

[13] Bose originally asserted that digital-to-analog conversion performed by the Schrager's processor is a SQE. Appx831. Consistent with the fact that Schrager does not describe or disclose any SQE performed by the DSP, Bose, however, back tracked and requested that the Board "not even [address] this argument." Appx1246. The Board acceded to Bose's request and did not address that argument in the FWD.

a. No Substantial Evidence Shows that it was Well Known to Include a DSP in a TWS Earbud to Provide a SQE for Audio Played by the Earbud, and that also Receives Firmware Upgrades, Prior to the '934 Patent, Due to Size and Power Constraints

Schrager's DSPs do not provide a SQE for audio that is played audibly by Schrager's speaker. Schrager discloses a headset device with a processor, which can be embodied with an "audio processor" such as a DSP. Appx7713, 5:54–58. Schrager, however, does not disclose that the DSP provides a SQE for output audio or that the "audio processing" involves a SQE.

Moreover, no reasonable person would accept the Board's findings regarding Schrager because at the time of the invention, SQEs were primarily limited to non-TWS earbuds. Bose's expert Casali, for example, testified that prior to the invention it was known to use DSPs in headsets with earcups. Appx2620–2622, ¶58 (citing Appx8340, ¶¶[0005]–[0007]; Appx8433, 1:7–2:24; Appx8552, ¶[0026]). The difference in size between a headset with earcups and TWS earbuds is significant. Appx11287–11288, ¶¶34–35. To that end, the evidence before the Board showed that compacting a DSP that provides a SQE for output audio into a small TWS earbud, with all of the other components needed to make an operable TWS earbud, including firmware upgrades as recited in claim 1, would have been a challenge for a POSA due to the competing size and power constraints for TWS earbuds. Appx11312–11314, ¶¶74–76.

In contrast to the limitations of Schrager, the ’934 Patent provides a solution to that challenge by using a SOC for the transceiver circuit, “which is conducive to miniaturizing the components of the earphone 10, which is advantageous if the earphone 10 is to be relatively small in size, such as an in-ear earphone” as shown in Figures 1A and 1B of the ’934 Patent. Appx247, 6:43−48; Appx11316−11317, ¶¶81−82.

Goldstein’s disclosure does not change this analysis. In other words, even considering Goldstein, there is no substantial evidence supporting the Board’s determination that claim 56 would have been obvious under Ground 1A for the ’934 Patent. Goldstein discloses an earbud at Goldstein’s Figure 5A, and Figure 5B is a block diagram of the internal components of that illustrated earbud. Appx3135; Appx3137, ¶¶[0010]−[0011]; Appx3141, ¶¶[0069]−[0070]. The illustrated earbud includes a “core logic 570,” but Goldstein’s description of the Figure 5A earbud does not explain that the core logic 570 is (or comprises) a DSP or that the core logic 570 provides a SQE for audio played by the earbud. Appx3141, ¶¶[0069]−[0070]. Outside of Goldstein’s description of Figure 5A earbud, Goldstein explains that a core logic can include “DSP code,” but Goldstein does not explain what the DSP code does or comprises. *Id.*, ¶[0067]. Bose cited Goldstein’s ¶¶[0090]−[0091] (Appx3143) as disclosing a DSP that provides a SQE (*see* Appx40−41, citing Appx831), but these paragraphs of Goldstein do not disclose that the DSP performs

any SQE or that such a DSP could be included in Goldstein's Figure 5A earbud. Thus, no substantial evidence supports the Board's determination.

b. The Board Abused its Discretion that Koss Waived Arguments about Goldstein

The Board also found that Koss waived any argument that if Goldstein's Figure 5A TWS earbud includes a DSP, there is no evidence that such a DSP performs a SQE for audio played by the earbud. Appx44. The Board abused its discretion with this finding because it is clearly unreasonable and arbitrary. The Board stated that Koss first made this argument in its Sur-reply, thereby making it an untimely, "new argument." *Id.* Koss, however, raised the argument in its Patent Owner Response (POR), where Koss argued that Goldstein does not disclose an earbud with a DSP and that DSPs for active noise cancellation (a form of SQE according to the '934 Patent) were only common in larger over-the-ear headphones, not in TWS earbuds. Appx1172−1173. The argument in the Sur-reply echoes the original argument presented in the POR and responds to arguments in Bose's Reply. *See* Appx1247−1248. Thus, the argument presented in the Sur-reply clearly was not new. The arbitrary nature of the Board's determination is shown by the fact that the Board permitted Bose to expound with new explanations in its Reply on arguments in its Petition. Appx83 (Board allowing Bose to include new diagram in its Reply). Thus, the Board's finding that Koss's argument was new was clearly unreasonable and arbitrary, and the Board erred to the extent it did not consider it.

While the Board alternatively found in Bose's favor "even if [the argument was] timely" (Appx44), there is no substantial evidence supporting that conclusion for at least the reasons discussed above. None of the references disclose an earbud with a DSP that provides a SQE for audio played by the earphone, and that receives firmware upgrades. Due to the size and power constraints of a TWS earphone, it would not have been obvious for a POSA to arrive at the subject matter of claim 56, as a whole, at the '934 Patent's earliest effective filing date. Appx11316−11317, ¶¶81−82.

D. <u>Ground 2C</u>

In Ground 2C, Bose relied on Rezvani-875's DSP as the DSP recited in claim 56. Appx871−872 (claim 52); Appx887 (claim 56, and relying on arguments for claim 52). Rezvani-875's DSP, however, is used for speech recognition. It extracts features in an acoustic signal; the extracted features are input to a speech recognizer; and the speech recognizer recognizes a command to locate a desired file. Appx2973, Fig. 3; Appx2982, ¶¶[0022]−[0024]. Thus, no substantial evidence supports that Rezvani-875's DSP provides a SQE for audio played by an earphone. Appx11314−11315, ¶78. In other words, Rezvani-875's DSP is for processing audio that is transmitted from the headset, rather than processing audio that is played by the headset.

Nevertheless, the Board found that using a DSP to enhance playback sound

quality would have been a routine implementation that a POSA would have had reason to pursue. Appx84. As support for this conclusion, the Board cited that by the mid-2000s, "there were well-known benefits to using DSPs for playback sound quality enhancement." Appx85 (quoting Appx1248−1249). No evidence of record, however, shows that using DSPs for a SQE for audio played by a TWS earbud was well known for TWS earbuds as recited in claim 56. Appx86 (Board acknowledging that Koss might have been correct on this point).

The Board found that Koss did not address Bose's "reliance on the knowledge of skilled artisans [a]s supported by combined teachings of the references and the other record evidence showing that DSP sound quality enhancement techniques for audio content played by the acoustic transducers generally were known." *Id.* (citing Appx872). No reasonable person would accept Bose's position, or the Board's adoption of it, as adequate, however, because it lacks any explanation as to why it would have been obvious to include such a DSP in a TWS earbud that also receives firmware upgrades, as required by claim 56. In fact, Bose's petition ignored that claim 56 requires a TWS earbud, with its attendant size and power constraints. Appx11287, ¶34; Appx11312−11314, ¶¶74−76. Instead, Bose's petition for claim 56 merely referred to its analysis for claim 52, which does not recite a TWS earbud. Appx872−873. Thus, no substantial evidence shows that claim 56, as a whole, would have been obvious. *See W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d

1540, 1548 (Fed. Cir. 1983) (distilling an invention down to its "gist" or "heart" disregards the statutory requirement of analyzing the subject matter "as a whole"). In contrast, the evidence below shows that it would not have been obvious to include such a DSP in a TWS earbud, which also receives firmware upgrades, due to the size and power constraints for TWS earbuds, the very problem that the '934 Patent solves by using a power- and space-conserving SOC. Appx11316−11317, ¶¶81−82.

Still further, no reasonable person would accept as adequate the Board's reliance on Williams's testimony regarding Oh. Appx85−86. Oh discloses an "echo eliminating circuit using" a DSP. Appx7676, ¶[44]. However, the echo eliminating circuit is used to eliminate echoes on sounds picked up by Oh's "voice detecting unit" and transmitted to "a person on the other end of the communication line" during a call. *Id.*, ¶[43]. Thus, Oh's DSP is not for providing a SQE for audio played by, or transmitted to the earphone as in claim 56, but rather it is for audio captured by, and transmitted from, Oh's earphone. This is clear from Oh's Figure 5, where the echo noise elimination circuit 503 is located in the signal path with the voice detecting unit 41, not in the signal path with the speaker 44. Appx7688, Fig. 5; Appx7677−7678, ¶¶[51]−[60]. Oh's DSP is, therefore, used for improving the quality of audio picked up by Oh's microphone (i.e., "voice detecting unit") and transmitted over a network on a call, and not used for improving the sound quality of the audio transmitted to, and played by, the earphone.

Two other references cited by Williams and the Board, Eichler (Appx8326−8355) and Polk (Appx8356−8395), are also inadequate to support the Board's findings because they similarly do not disclose a DSP in a TWS earbud for providing a SQE for audio played by the earphone. Indeed, neither Williams nor the Board assert that they do. Appx85−86; Appx2490−2492, ¶392.

Therefore, this Court should reverse the invalidation of claims 56 and 57 of the '934 Patent.

V. CONCLUSION

Because the Board erred as described above, this Court should reverse the Board's erroneous invalidation of: (i) claims 40−43, 46, 48 and 51, i.e., the "elongated portion" form factor claims, of the '025 Patent; (ii) claims 29−31, 34, 36 and 53, i.e., the "hanger bar" form factor claims, of the '025 Patent; and (iii) claims 56 and 57, i.e., the TWS earbud DSP claims, of the '934 Patent.

Dated: March 6, 2023

Respectfully submitted,

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ADDENDUM

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Paper 37
Entered: Oct. 7, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BOSE CORP.,
Petitioner,

v.

KOSS CORP.,
Patent Owner.

IPR2021-00680
Patent 10,469,934 B2

Before KARL D. EASTHOM, PATRICK R. SCANLON, and DAVID C. McKONE, *Administrative Patent Judges.*

EASTHOM, *Administrative Patent Judge*, with whom Judges Scanlon and McKone join as to Sections I, II A–F.1, and II.K.

McKONE, *Administrative Patent Judge* with whom *Administrative Patent Judge* Scanlon joins as to Sections II.F.2, II.H, and II.J.

EASTHOM, *Administrative Patent Judge*, dissenting as to Sections II.F.2, II.H, and II.J.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
35 U.S.C. § 318(a)

Bose Corp. ("Petitioner") filed a Petition (Paper 2, "Pet.") requesting an *inter partes* review of claims 1–22, 32–41, 47, and 49–62 of U.S. Patent No. 10,469,934 B2 (Ex. 1001, "the '934 patent"). Pet. 1. Petitioner filed a Declaration of Dr. Tim A. Williams (Ex. 1003) and a Declaration of Dr. John G. Casali (Ex. 1005) with its Petition. Koss Corp. ("Patent Owner") filed a Preliminary Response (Paper 10, "Prelim. Resp.").

After the Institution Decision (Paper 15, "Inst. Dec."), Patent Owner filed a Patent Owner Response (Paper 21, "PO Resp."), a Declaration of Joseph C. McAlexander III (Ex. 2047), and a Declaration of Nicholas S. Blair (Ex. 2048); Petitioner filed a Reply (Paper 27) and a Reply Declaration of Dr. Tim A. Williams (Ex. 1160); and Patent Owner filed a Sur-reply (Paper 29, "Sur-reply"). Thereafter, the parties presented oral arguments via a video hearing (March 17, 2022), and the Board entered a transcript into the record. Paper 36 ("Tr.").

For the reasons set forth in this Final Written Decision pursuant to 35 U.S.C. § 318(a), we determine that Petitioner demonstrates by a preponderance of evidence that the challenged claims are unpatentable.

I. BACKGROUND

A. Real Parties in Interest

The parties identify themselves as the real parties-in-interest. Pet. xix; Paper 3, 1.

B. Related Matters

The parties identify the following proceedings as related matters involving the '934 patent: *Koss Corp. v. Bose Corp.*, No. 6:20-cv-00661 (W.D. Tex.) (dismissed); *Koss Corp. v. Plantronics, Inc.*, No. 6:20-cv-00663 (W.D. Tex.) (transferred to N.D. Cal.); *Koss Corp. v. Skullcandy, Inc.*, No. 6:20-cv-00664 (W.D. Tex.) (dismissed); *Koss Corp. v. Apple Inc.*, No. 6:20-

cv-00665 (W.D. Tex.); *Bose Corp. v. Koss Corp.*, No. 1:20-cv-12193 (D. Mass.); *Apple Inc. v. Koss Corp.*, No. 4:20-cv-05504 (N.D. Cal.); *Apple Inc. v. Koss Corp.*, No. 6:21-cv-00495 (W.D. Tex.); *Koss Corp. v. Skullcandy, Inc.*, No. 2:21-cv-00203 (D. Utah). Pet. xx–xxi; Paper 3, 1; Paper 5, 1; Paper 7, 2.

In addition, the parties indicate, and/or Board records show, that the following *inter partes* review proceedings challenging the ’934 patent or patents related to the ’934 patent are related matters: *Apple Inc. v. Koss Corp.*, IPR2021-00255 (challenging U.S. Patent No. 10,298,451 B1) (final written decision, notice of appeal filed August 1, 2022); *Bose Corp. v. Koss Corp.*, IPR2021-00297 (challenging U.S. Patent No. 10,368,155 B2) (final written decision, notice of appeal filed Aug. 1, 2022); *Apple Inc. v. Koss Corp.*, IPR2021-00305 (challenging U.S. Patent No. 10,506,325 B1) (final written decision, notice of appeal filed Aug. 1, 2022); *Apple Inc. v. Koss Corp.*, IPR2021-00381(challenging U.S. Patent No. 10,491,982 B1) (final written decision, notice of appeal filed Aug. 9, 2022); *Bose Corp. v. Koss Corp.*, IPR2021-00546 (challenging U.S. Patent No. 10,206,025 B2) (institution denied Oct. 8, 2021); *Apple Inc. v. Koss Corp.*, IPR2021-00592 (challenging U.S. Patent No. 10,469,934 B2) (settled/terminated, Aug. 2, 2022); *Apple Inc. v. Koss Corp.*, IPR2021-00600 (challenging U.S. Patent No. 10,298,451 B1) (settled/terminated, Aug. 2, 2022); *Bose Corp. v. Koss Corp.*, IPR2021-00612 (challenging U.S. Patent No. 10,206,025 B2) (final written decision filed Sept. 13, 2022); *Apple Inc. v. Koss Corp.*, IPR2021-00626 (challenging U.S. Patent No. 10,206,025 B2) (institution denied Sept. 30, 2021); *Apple Inc. v. Koss Corp.*, IPR2021-00679 (challenging U.S. Patent No. 10,506,325 B1) (institution denied Oct. 12, 2021); *Apple Inc. v. Koss Corp.*, IPR2021-00686 (challenging U.S. Patent No. 10,491,982 B1)

(institution denied Oct. 12, 2021); *Apple Inc. v. Koss Corp.*, IPR2021-00693 (challenging U.S. Patent No. 10,469,934 B2) (institution denied Oct. 13, 2021). Pet. xx; Paper 3, 1; Paper 5, 1; Paper 7, 2.

C. The ’934 Patent

The ’934 patent, titled “System with Wireless Earphones,” issued November 5, 2019, with claims 1–62, and claims priority through several applications dating to April 7, 2008. Ex. 1001, codes (45), (54), (60), (63), 1:3–30, 18:2–25:23. The ’934 patent relates to “a wireless earphone that comprises a transceiver circuit for receiving streaming audio from a data source, such as a digital audio player or a computer, over an ad hoc wireless network.” *Id.* at 1:67–2:3. The ’934 patent defines an “ad hoc wireless network” as “a network where two (or more) wireless-capable devices, such as the earphone and a data source, communicate directly and wirelessly, without using an access point.” *Id.* at 3:3–6. Some embodiments include two discrete wireless earphones, one in each ear. *Id.* at 3:47–48.

Figure 2A of the ’934 patent follows:

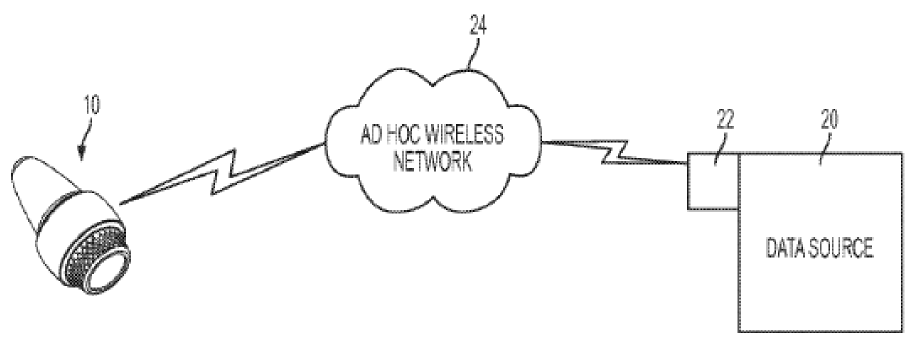

FIG. 2A

Figure 2A illustrates wireless earphone 10 connected via ad hoc wireless network 24 to data source 20. Ex. 1001, 4:26–28. “[D]ata source 20 may be a digital audio player (DAP), such as an [MP]3 player or an iPod, or any

other suitable [DAP] device, such as a laptop or personal computer, that stores and/or plays digital audio files." *Id.* at 4:32–36. "When in range, the data source 20 may communicate with the earphone 10 via the ad hoc wireless network 24 using any suitable wireless communication protocol," including Wi-Fi, Bluetooth, and other communication protocols. *Id.* at 4:56–61.

In one embodiment, earphone 10 connects to network-enabled host server 40 via networks 30a, 42 so that host server 40 can transmit streaming digital audio to earphone 10. Ex. 1001, 5:56–62, Fig. 2D. Alternatively, host server 40 may transmit a network address to earphone 10 for streaming digital audio content server 70. *Id.* at 5:62–65, Fig. 2D. In this case, earphone 10 uses the received address to connect to content server 70 via networks 30a, 42 and receive digital audio from content server 70. *Id.* at 5:66–6:2. In one embodiment, content server 70 is an Internet radio station server. *Id.* at 6:3–4. In addition, content server 70 may stream digital audio received from data source 20 via networks 30b, 42. *Id.* at 6:7–12.

Figure 3 follows:

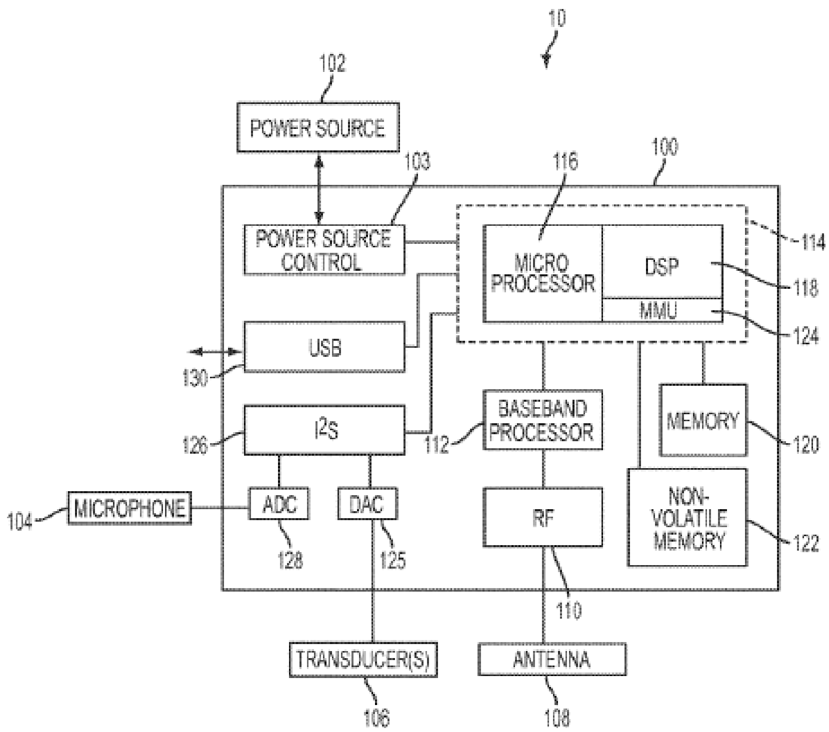

FIG. 3

Figure 3 depicts a block diagram of earphone 10. *Id.* at 2:31–32. As Figure 3 shows, earphone 10 includes transceiver circuit 100, power source 102, microphone 104, acoustic transducer 106 (e.g., a speaker), and antenna 108. *Id.* at 6:30–35. The body of earphone 10 houses transceiver circuit 100, power source 102, and acoustic transducer 106 in some embodiments, with microphone 104 and antenna 108 external to the body. *Id.* at 6:33–40.

D. Illustrative Claim

Independent claim 1 follows:

> [1A] A headphone assembly comprising:
>
> [1B] first and second earphones, wherein each of the first and second earphones comprises an acoustic transducer; and
>
> [1C] an antenna for receiving wireless signals from a mobile, digital audio player via one or more ad hoc wireless communication links;
>
> [1D] a wireless communication circuit connected to the antenna, wherein the wireless communication circuit is for receiving and transmitting wireless signals to and from the headphone assembly;
>
> [1E] a processor;
>
> [1F] a memory for storing firmware that is executed by the processor;
>
> [1G] a rechargeable battery for powering the headphone assembly; and
>
> [1H] a microphone for picking up utterances by a user of the headphone assembly;
>
> [1I] and wherein the headphone assembly is configured to play, by the first and second earphones, digital audio content transmitted by the mobile, digital audio player via the one or more ad hoc wireless communication links;
>
> [1J] wherein the processor is configured to, upon activation of a user-control of the headphone assembly, initiate transmission of a request to a remote, network-connected server that is in wireless communication with the mobile, digital audio player;
>
> [1K] and wherein the headphone assembly is for receiving firmware upgrades transmitted from the remote, network-connected server.

Ex. 1001, 18:2–33 (bracketed nomenclature added). *See* Pet. 5–6. Claim 58 is the only other independent claim challenged. It is similar to claim 1 in that it includes the same limitations as claim 1 except limitations 1F and 1K,

and unlike claim 1, it also includes a "Signal Strength" limitation, as discussed below. *See infra* II.F.2.

E. Asserted Grounds of Unpatentability

Petitioner contends that the challenged claims would have been unpatentable on the following grounds:[1]

Claim(s) Challenged	**35 U.S.C. §**	**Reference(s)/Basis**
1–3, 5, 7, 9–11, 32–37, 39, 47, 49, 51–57	103(a)	Schrager,[2] Goldstein[3]
4, 6, 8, 12, 13, 38, 40, 41, 58–62	103(a)	Schrager, Goldstein, Harada[4]
14–16, 19, 21, 49–51	103(a)	Schrager, Goldstein, Skulley[5]
17, 18, 20, 22	103(a)	Schrager, Goldstein, Skulley, Harada
1–3, 5, 7, 9–11, 14–16, 19, 21, 47, 49–53	103(a)	Rezvani-446,[6] Rezvani-875,[7] Skulley, Hind[8]
4, 6, 8, 12–13, 17, 18, 20, 22, 58–62	103(a)	Rezvani-446, Rezvani-875, Skulley, Hind, Harada
32–37, 39, 54–57	103(a)	Rezvani-446, Rezvani-875, Oh,[9] Hind

[1] The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) ("AIA"), amended 35 U.S.C. § 103. Because the '934 patent's effective filing date precedes the March 16, 2013, effective date of the applicable AIA amendments, the pre-AIA version of 35 U.S.C. § 103 applies.
[2] US 7,072,686 B1, issued July 4, 2006 (Ex. 1101).
[3] US 2008/0031475 A1, published Feb. 7, 2008 (Ex. 1026).
[4] US 2006/0229014 A1, published Oct. 12, 2006 (Ex. 1098).
[5] US 6,856,690 B1, issued Feb. 15, 2005 (Ex. 1017).
[6] US 2007/0136446 A1, published June 14, 2007 (Ex. 1097).
[7] US 2007/0165875 A1, published July 19, 2007 (Ex. 1016).
[8] US 7,069,452 B1, issued June 27, 2006 (Ex. 1019).
[9] WO 2006/098584 A1, published Sept. 21, 2006 (Ex. 1099).

Claim(s) Challenged	**35 U.S.C. §**	**Reference(s)/Basis**
38, 40, 41	103(a)	Rezvani-446, Rezvani-875, Oh, Hind, Harada

Pet. 2–3.

II. ANALYSIS

A. Level of Ordinary Skill in the Art

Determining whether an invention would have been obvious under 35 U.S.C. § 103 requires resolving the level of ordinary skill in the pertinent art at the time of the effective filing date of the claimed invention. *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966). The person of ordinary skill in the art is a hypothetical person who knows the relevant art. *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). Factors in determining the level of ordinary skill in the art include the types of problems encountered in the art, the sophistication of the technology, and educational level of active workers in the field. *Id.* One or more factors may predominate. *Id.*

Petitioner contends that a person having ordinary skill in the art "would have had background in wireless networks, including at least a bachelor's degree in electrical engineering or a related field and experience with wireless networks, and would have worked on a team including members with headphone-design experience." Pet. 6 (citing Ex. 1003 ¶¶ 30–37; Ex. 1005 ¶¶ 41–45).

Patent Owner "proposes a slightly different skill level." PO Resp. 7. Patent Owner contends "that a POSA 'would be someone working in the electrical engineering field and specializing in or knowledgeable of speaker components for small wireless devices.'" *Id.* (quoting Ex. 2047 ¶ 19). Patent Owner adds that "[t]he POSA would have a bachelor's degree in

electrical engineering and at least two years of work experience in the industry. *Id.* (citing Ex. 2047 ¶ 19). Therefore, "the POSA would have studied and have practical experience with circuit design, speaker components, and wireless communication." *Id.* (citing Ex. 2047 ¶ 19).

Patent Owner argues that "Petitioner's expert acknowledges" that "the '934 [p]atent relates to headphones," and "under Patent Owner's proposal, the POSA specializes in, or has knowledge of, speaker components for small wireless devices," but "Petitioner's [proposal of a] POSA does not have such skill." PO Resp. 7–8.

As Patent Owner argues, its proposed skill level is only "slightly different" than Petitioner's. PO Resp. 7. The two proposals do not materially differ. Patent Owner argues that "Petitioner's POSA does not have" "knowledge of[] speaker components for small wireless devices." *See Id.* at 8. Contrary to this argument, however, under Petitioner's proposal, the artisan of ordinary skill "would have worked on a team including members with headphone-design experience." Pet. 6. By working on such a team, Petitioner's proposed person of ordinary skill person at least would have gained "knowledge of[] speaker components for small wireless devices," thereby satisfying Patent Owner's proposed level of skill. *Compare* PO Resp. 8, *with* Pet. 6.

Dr. Williams supports this finding by testifying that under his proposal, teams of "one or more" work "in coordination to modify the design to fit each other team's constraints and desired attributes (e.g., how much the device should weigh; the shape of the device and how much room was needed for various components and subsystems; the wireless protocols supported by the device; etc.) as best as possible." Ex. 1003 ¶ 33. And "[u]sing their ordinary skill, the teams would iteratively work on the

different aspects of the product until reaching a final design that met all of the desired functional and physical attributes of the product." *Id.*

Dr. Casali corroborates Dr. Williams's testimony, testifying that he

> agree[s] that in the art of headphone assembly design for a wireless headphone assembly, a person would have a background in wireless technology and, if that person did not have sufficient experience with headphone design, would have been a member of a team including at least one other person with a background in engineering or product design bringing experience in headphone design.

Ex. 1005 ¶ 42. He also testifies that "the engineer or product designer with headphone design experience . . . would have worked in the collaborative team, as described above in Paragraph 41." *Id.* ¶ 43. In other words, a person of ordinary skill either would have sufficient direct experience in headphone design or would have gained some knowledge of headphone design after having collaborated on a team.

Based on our review of the record, Petitioner's stated level of ordinary skill in the art is reasonable because is consistent with the evidence of record, including the asserted prior art, and the breadth of the claims. For the reasons explained above, it implicitly includes what Patent Owner's proposal additionally requires, namely that a person of ordinary skill would have "knowledge of[] speaker components for small wireless devices"—either by working on a team or otherwise. *See* PO Resp. 8.

Regarding claim breadth as it relates to this knowledge of speaker components and the sophistication of the technology, *see GPAC*, 57 F.3d at 1579, the challenged claims at most recite well-known and generic form factors (headphone types or design shapes). For example, claim 33 depends from claim 1 and recites "each of the first and second earphones comprises earbuds." Claim 34 depends from claim 33 and recites "each of the first and

second earphones comprises: a body portion that sits at least partially in an ear of the user when the headphone assembly is worn by the user; and an elongated portion that extends from the body portion." These claims do not specify how the earphones include, or whether the body portion or elongated portion includes, the transducer, antenna, circuit, processor, memory, microphone, or rechargeable battery of claim 1. The '934 patent specification states that "the earphone may take different shapes and the exemplary shapes shown in FIGS. 1A and 1B are not intended to be limiting." Ex. 1001, 2:63–65.

Dr. Casali persuasively testifies, with record evidentiary support, that the various "form-factors" at issue in this proceeding were well-known and fell into "three general types":

> As Skulley corroborates as part of its background information, by 2008, it was known that both monaural and stereo headphone designs "can be classified into ***three general types*** in accordance with the type of ear-phone that they employ: 1) '***In-the-ear***' type [intra-aural] earphones, sometimes referred to as 'ear buds,' which fit into the concha, or entrance to a wearer's middle ear, such as that described in U.S. Pat. No. 5,761,298 to M. Davis, et al." ("Davis," Ex. 1033), which illustrates an in-the ear design with a support structure (*e.g.*, earhook 13, *see Davis* (Ex. 1033), 4:40–41) that wraps around and behind the ear; "2) '***On-the-ear***' types [supra-aural] that couple against a lateral face of the auricle [also known as pinna], or external ear, of the wearer, such as that described in U.S. Pat. No. 5,960,094 to W. Jensen, et al.; and, 3) ***'Over-the-ear***' types [circum-aural] that surround and form a closed chamber over the auricle of the listener, such as that described in U.S. Pat. No. 6,295,366 to L. Haller, et al." ("Haller," Ex. 1035). *See Skulley* (Ex. 1017), 1:22–34. Again, these general types can be termed "form factors," which I will illustrate and address in Paragraphs 51–52 below.

Ex. 1005 ¶ 50 (footnotes omitted).

Accordingly, for the purposes of this Decision, we adopt Petitioner's proposal, which implicitly includes Patent Owner's additional proposed requirement. As noted above, Patent Owner acknowledges its proposal is only "slightly different" than Petitioner's proposal. PO Resp. 7. Accordingly, based on the discussion above and the record, a person of ordinary skill would have "knowledge of[] speaker components for small wireless devices" (*id.* at 8) by working on a team or otherwise. In addition, this person of ordinary skill "would have had background in wireless networks, including at least a bachelor's degree in electrical engineering or a related field and experience with wireless networks." *See* Pet. 6 (citing Ex. 1003 ¶¶ 30–37; Ex. 1005 ¶¶ 41–45).

B. Weight of Declarant's Testimony

1. Dr. Williams and Mr. McAlexander

Petitioner does not challenge the testimony of Mr. McAlexander, Patent Owner's declarant.[10]

Patent Owner argues that the testimony of Dr. Williams, Petitioner's declarant, "should be afforded little if any weight for three reasons." PO Resp. 63. First, "the opinions expressed in his declaration (BOSE-1003) are founded on a POSA skill level that he, in fact, did not use, thereby rendering his opinions valueless." *Id.* According to Patent Owner, during cross-examination, Dr. Williams "recant[ed] . . . his original POSA skill level" that he specified during "his declaration" (Ex. 1003), and "instead applied a POSA skill level where a POSA 'is a team of people who have experience in

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[10] Petitioner asserts that Mr. McAlexander "lacks head-phone design experience," but does not argue his testimony should be discounted. *See* Reply 26.

wireless networking and people who have experience in headset design.'" *Id.* (quoting Ex. 2046, 30).

Patent Owner advances two other arguments that hinge on the first argument: 1) "because Williams said a POSA is a team [during his cross-examination], his opinions are contrary to the law"; and 2) "at bottom, his conflicting POSA standards make his testimony unreliable. It is unclear what skill level Williams applied for a POSA in his obviousness opinions." PO Resp. 64–65. Patent Owner advances similar arguments in its Sur-reply. *See* Sur-reply 2 ("Simply put, Williams did not perform the analysis that he swore to in his original declaration, which undercuts his overall credibility.").

Dr. Williams relies on the testimony of Dr. Casali (Petitioner's other declarant, *see infra* § II.B.2), "concerning the relevant headphone design features in much the same way that a POSA (*i.e.*, an individual with expertise in wireless networking as described above) would have worked with an individual with specific experience in headphone design when designing a wireless headphone product." Ex. 1003 ¶ 36. Patent Owner agrees that Dr. Williams does not advance that a POSA is a team in his original declaration. *See* PO Resp. 63–65. Rather, Dr. Williams applies the concept of a team *member* having gained the requisite knowledge of speakers for small wireless devices through other team members, such as Dr. Casali. *See* Ex. 1003 ¶ 36. In other words, in preparation for this trial, Dr. Williams studied the declaration of Dr. Casali, and other evidence, including the prior art of record. *See id.* ¶¶ 15, 36. Patent Owner does not dispute that Dr. Williams at least has the requisite level of ordinary skill to testify in this proceeding. *See* PO Resp. 62–65.

Moreover, Dr. Williams applies the level of ordinary skill as he states in his declaration, and this does not conflict with his deposition. *See* Ex. 1003 ¶ 36 ("A POSA would have been capable of understanding and applying the teachings of the '934 patent and the prior art references discussed in this declaration."). Contrary to Patent Owner's argument, Dr. Williams did not indicate on cited page 30 of his deposition that he "recant[ed] . . . his original POSA skill level." *See* PO Resp. 63 (citing Ex. 2046, 30). Rather, he testifies that he "would be *one of the members* of the team of that POSA team." *See* Ex. 2046, 30 (emphasis added). During his deposition, Dr. Williams confirmed his

> opinion that, as I express in the bottom part of . . . paragraph [35 of my original declaration], in this case, a POSA would have worked on a team with someone knowledgeable with headphone form factors. *But that does not change the definition of a POSA as an individual with wireless networking experience because the art to which the purported technical advance of the '934 patent principally relates is wireless networking*.

Id. at 35:14–18 (emphasis added); *accord* Reply 33 (quoting part of the same passage (citing Ex. 2046, 35–36)).

As discussed above (§ II.A), and as Dr. Williams's testimony shows, each member of the team at least would have gained "some knowledge of speaker components for small wireless devices" (as Patent Owner proposes) by working on that team or otherwise through other experience. As also noted, Dr. Williams relies on Dr. Casali's testimony and the record evidence here to gain the required headphone knowledge. *See* Ex. 1003 ¶ 15 (listing the record evidence as materials he "studied and considered," including Dr. Casali's declaration (Ex. 1005)), ¶¶ 35–37 (equating his reliance on Dr. Casali's declaration as a team member through which Dr. Williams testifies he "assumed the perspective of a person having ordinary skill in the

art" to form his opinion). As also found above, this required knowledge (in addition to knowledge of wireless networks), only requires some rudimentary knowledge about well-known form factors, given the breadth of the claims at issue here. As Dr. Williams testifies, "the art to which the purported technical advance of the '934 patent principally relates is wireless networking." Ex. 2046, 35:19–21.

Moreover, Mr. McAlexander, Patent Owner's declarant, similarly lacks direct experience in headphone design. And Mr. McAlexander and Dr. Williams each worked in cell phone design, which includes small speakers. *Compare* Ex. 1003 ¶ 3 (testifying "I have also designed cellular chipsets for operation in cellular phones" and "I have over 40 years of professional experience in wireless communications and telecom technology"), *with* Ex. 2047 ¶ 8 (testifying that he "investigated processes and designs associated with . . . telephones"). Mr. McAlexander also testifies that an artisan of ordinary skill "would be someone working in the electrical engineering field and specializing in or knowledgeable of speaker components for small wireless devices." Ex. 2047 ¶ 19. But Mr. McAlexander does not testify that this knowledge must be direct knowledge, and he does not testify that he worked directly with small speakers. Rather, he generally testifies that he "investigated processes and designs associated with . . . telephones": "I have investigated processes and designs associated with personal computers, peripheral computers, software, and wireless communications systems, including telephones, microprocessors, controllers, memories, programmable logic devices, and other consumer electronics." *Id.* ¶ 8; *see also id.* ¶¶ 1–7, 9 (testifying "I am very familiar with how acoustic speakers operate and the design issues associated with sound systems" without mentioning the size of the

speakers.). During his deposition, Mr. McAlexander agreed that he "had not ever designed a headphone" and that "outside of litigation counseling," he had "not worked on any specific projects that are related to the headphone." Ex. 1146, 7:13–23.

Nevertheless, Mr. McAlexander testifies that "I satisfied this skill level circa 2008–2009 (and satisfy it now); and I am familiar with the knowledge and skills that a person with this skill level would have possessed circa 2008–2009 through my work and interaction with colleagues in the field." Ex. 2047 ¶ 19.

Patent Owner also faults Dr. Williams's credibility because Dr. "Williams knew of the infringement allegations, yet he ignored the plain evidence that he reviewed due to the strawman that Patent Owner had not 'asserted' commercial success." PO Resp. 61. Contrary to Patent Owner's arguments, it is not clear how or why not addressing something not asserted before institution diminishes a declarant's testimony, even if there is "potential commercial success" possibly raised during trial. *See id.* at 62.

Patent Owner also argues that "Williams's testimony on the topic should be disregarded because he admitted that he neither understands the relevant law (KOSS-2062, 38) nor how the commercially successful product functions." Sur-reply 24. This argument over-generalizes the testimony of Dr. Williams. At page 36–38 of his deposition, Dr. Williams testifies as to not understanding "the law" pertaining to "commercial success" in relation to Patent Owner's hypothetical questions centered on a district court complaint (Ex. 1055) filed by Patent Owner in which Patent Owner's deposition questions "assume" that Bose's patent claims read on Bose's QC35 earbuds. *See* Ex. 2062, 37:24–38:3 ("Does there have to be complete correspondence between a claim and one of the Bose patents that Bose

claims reads on the QC35 for the commercial success of the QC35 to be evidence of a nonobviousness of the Bose patent claim?”). It is not clear how such a hypothetical question about “complete correspondence” of a patent claim to a Bose product, where Bose’s claims and products are not at issue in this case, sheds any light on Dr. Williams’s credibility. Patent Owner also fails to tie specific portions of Dr. Williams’s declaration testimony about “the topic” to show how any such portion relates to credibility based on such a hypothetical question about Bose products. Patent Owner’s proposed level of skill also does not assert that knowledge of “the topic” is a prerequisite to testify in this trial. *See supra* § II.A. Moreover, Patent Owner acknowledges that Dr. Williams generally “testified that secondary considerations are one of the considerations involved in ‘the obviousness question.’” PO Resp. 62 (citing Ex. 1003 ¶ 25).

On this record, Patent Owner does not establish a persuasive reason to discount the weight associated with Dr. Williams’s testimony.

2. Dr. Casali and Mr. Blair

Patent Owner does not challenge the qualifications of Dr. Casali, Petitioner’s declarant, who testifies as to various form factors and known types of headphone assemblies and components. Likewise, Petitioner does not challenge the qualifications of Mr. Blair, Patent Owner’s declarant, who testifies to similar form factor topics regarding headphones. Neither Dr. Casali nor Mr. Blair appear to satisfy the level of ordinary skill as adopted herein.

Mr. Casali obtained “a B.S. in Psychology in 1977, a Master of Science in 1979, and a Ph.D. in Industrial Engineering with concentration in Human Factors Engineering in 1982.” Ex. 1005 ¶ 5. He testifies that “[t]he

most extensive core area of my work has involved the design and testing of hearing protection devices ("HPDs"), headsets, earphones, headphones, and hearing-protective Tactical Communications and Protective Systems ('TCAPS')." *Id.* ¶ 12. Mr. Blair's educational experience involves a Bachelor's in Fine Arts and the study of architecture, and he "devoted a large portion of [his] professional career researching human factors, ergonomics, and human biology as it relates to delivering personal audio in a safe, reliable, and comfortable manner." Ex. 2048 ¶ 4.

Nevertheless, we determine that the testimony of Dr. Casali and Mr. Blair is useful in this proceeding to shed light on form factors in relation to the design, including the use of well-known electronic components and design features, for different types of headphones. The prior art of record, the claims, and the '934 patent specification sufficiently indicate the requisite skill level. Accordingly, given the breadth of the claims and the fact that headphone form factors falling in the scope of the claims were well-known, there is no need to explicitly identify the requisite skill level required to testify as to topics about form factors of headphones and related topics, including topics involving known electronic components fitting into head phones, especially here where neither party challenges the qualifications of the other party's declarant in this regard. Moreover, even if we only consider the testimony of Dr. Casali and Mr. Blair as to how it supports the testimony of Dr. Williams and Mr. McAlexander, respectively, it would not alter the result.

C. Claim Construction

In *inter partes* reviews, the Board interprets claim language using the district-court-type standard, as described in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See* 37 C.F.R. § 42.100(b) (2020). Under

that standard, claim terms have their ordinary and customary meaning, as would be understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history. *See Phillips*, 415 F.3d at 1313–14. Any extrinsic evidence should be considered in the context of the intrinsic evidence. *See id.* at 1317–19.

Petitioner asserts that because "the prior art plainly discloses claim elements, express construction is unnecessary." Pet. 7–8 (citing *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017)).

Patent Owner also does not discuss claim construction explicitly in a separate claim construction section. *See generally* Prelim. Resp. However, addressing Petitioner's grounds, Patent Owner implies that the challenged claims require a server that

> would (i) receive the request initiated from the headphone assembly; (ii) transmit the firmware upgrades for the headphone assembly; and (iii) be in wireless communication with the DAP. It is not sufficient if any arbitrary server would perform one or more of the features (i), (ii), and (iii), . . . transmitting the firmware updates.

PO Resp. 20–21 (citing *See Apple Inc. v. Koss Corp.*, IPR2021-00546, Paper 10 at 18–19 (PTAB Sept. 7, 2021)). Contrary to this line of argument, which relies on a statement by the Board in IPR2021-00546, the claims challenged in IPR2021-00546 are distinctly different than the claims challenged here. Claim 1 challenged in IPR2021-00546 recites "[a] *system* comprising: a mobile, [DAP]. . . , a headphone assembly, . . . and a remote, network-connected server that is in wireless communication with the mobile, digital audio player." *See* IPR2021-00546, Paper 10 at 6 (emphasis added)

(quoting challenged claim 1 in a related patent). This *system* claim recites three major components, a DAP, a headphone assembly, and a server.

In contrast, challenged claim 1 here recites a *headphone assembly*, not a *system.* The claimed headphone assembly logically does not include an external DAP or server. Rather, the claimed headphone assembly requires the capability "for receiving wireless signals" from a DAP, and the capability to communicate with a server, including "for receiving firmware updates from the . . . server." These relationships with the DAP and server amount to limitations on the *structure of the headphone assembly* (including its processor) as implied by the "configured to" or "for receiving" functions recited with respect to the DAP and server—i.e., limitations on the capability of the headphone assembly to receive signals and play content from a DAP, to transmit a request to a server, and receive firmware updates from the server. But it is not clear how the relationship between the DAP and server, which are not part of the headphone assembly, alters the structure of the headphone assembly, or amount to more than an intended use of that relationship.

In pertinent part, claim 1 recites

> [1A] [a] *headphone assembly* comprising . . . [1C] an antenna for receiving wireless signals from a mobile, DAP . . . ; [1E] a processor . . . ; [1I] wherein the *headphone assembly* is *configured to* play . . . audio content transmitted by the mobile, [DAP]; [1J] wherein the *processor* is *configured to* . . . initiate transmission of a request to a remote, network-connected server that is in wireless communication with the mobile, [DAP]; [1K] and wherein the *headphone assembly is for receiving* firmware upgrades transmitted from the remote, network-connected server.

As noted in the Institution Decision,

> [n]otwithstanding Patent Owner's argument and Petitioner's showing that alleges the obviousness of a server wirelessly connected to a DAP . . . , neither party addresses how a processor configured to initiate the claimed transmission to a server is structurally different from the same processor configured to initiate the claimed transmission to the same server that is in turn connected wirelessly to a DAP.

See Inst. Dec. 10–11 (citing *In re Schreiber*, 128 F.3d 1473, 1477 (Fed. Cir. 1997) ("It is well settled that the recitation of a new intended use for an old product does not make a claim to that old product patentable."); *In re Anderson*, 662 F. App'x 958, 963 (Fed. Cir. 2016) (nonprecedential) ("We also agree with the Board that the 'for use' claim language is a statement of intended use. The 'for use' language does not add a structural limitation to the claimed system or method."); *ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018) ("[A] prior art reference may anticipate or render obvious an apparatus claim—depending on the claim language—if the reference discloses an apparatus that is reasonably capable of operating so as to meet the claim limitations . . . .").

With further respect to the claimed server functionality, it includes communication with a server farm or other grouping of networked servers. That is, according to the '934 patent specification, "[a]ny servers described herein . . . may be replaced by a 'server farm' or other grouping of networked servers (such as server blades) that are located and configured for cooperative functions." Ex. 1001, 17:45–49.

No need exists to construe explicitly any claim language because doing so would have no effect in the analyses below of Petitioner's asserted grounds and will not assist in resolving the present controversy between the parties. *See Nidec Motor*, 868 F.3d at 1017 (stating that "we need only construe terms 'that are in controversy, and only to the extent necessary to

resolve the controversy'" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Ground 1A: Schrager and Goldstein

Petitioner asserts that claims 1–3, 5, 7, 9–11, 32–37, 39, 47, 49, and 51–57 are unpatentable under 35 U.S.C. § 103(a) based on Schrager and Goldstein. Pet. 8–28. Patent Owner disagrees. PO Resp. 15–21, 52–61 (alleging commercial success); Sur-reply 4–15, 18–24.

1. Schrager

Schrager discloses "a portable electronic device which can include one or more of an AM/FM radio, a music player, a short distance radio, a voice memo pad, a cellular telephone, a global positioning system (GPS) receiver, an AM/FM radio interface, and a transponder." Ex. 1101, 4:55–59. Each of these units can be operated in a hands-free manner via voice commands. *Id.* at 4:60–62. Figure 1 of Schrager follows:

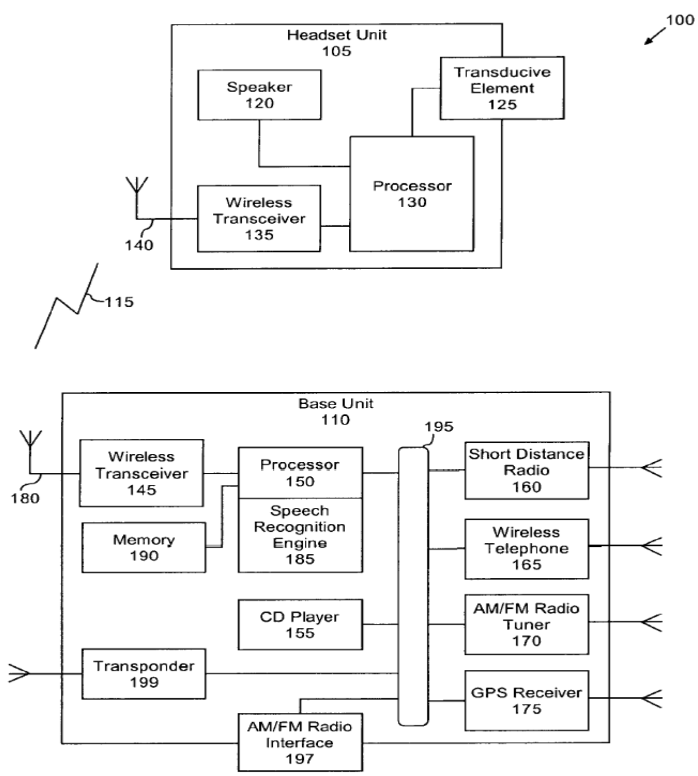


Figure 1 is a schematic diagram illustrating voice-controlled multimedia and communications device 100. Ex. 1101, 4:38–40, 4:66–5:2. Device 100 includes headset unit 105 and base unit 110 that communicate with each other via wireless communication link 115. *Id.* at 5:2–5. Headset unit 105 includes speaker 120, transducive element 125, processor 130, wireless transceiver 135, and antenna 140. *Id.* at 5:5–8. Processor 130 receives audio signals, control signals, and other data from base unit 110 through wireless transceiver 135. *Id.* at 5:44–46. Wireless transceiver 135 communicates with base unit 110 using any of a variety of short-range wireless protocols, including Bluetooth technology. *Id.* at 6:12–16.

Base unit 110 includes wireless transceiver 145, processor 150, and compact disc (CD) player 155 or other music source. Ex. 1101, 6:62–64. Wireless transceiver 145 wirelessly communicates with the headset unit's wireless transceiver 135 through antennas 140 and 180. *Id.* at 6:67–7:3.

2. Goldstein

Goldstein relates to the storage and recall of audio content, such as the storage and playing of music or verbal content on a system built into a headphone. Ex. 1026 ¶ 2. "At least one exemplary embodiment is directed to a system for Personalized Services delivered to a Personal Audio Assistant incorporated within an earpiece (e.g., earbuds, headphones)." *Id.* ¶ 17. The earpiece or headphone system includes Personal Audio Assistant (PAA) for digital audio playback of downloaded content. *Id.* ¶ 18. This PAA is "within an earpiece (e.g., earbuds, headphones)." *Id.* ¶ 19. "[T]he Personal Audio Assistant [PAA] . . . is managed from a Server system," which seamlessly manages and downloads audio content to the PAA. *Id.*

Figure 1 of Goldstein follows:

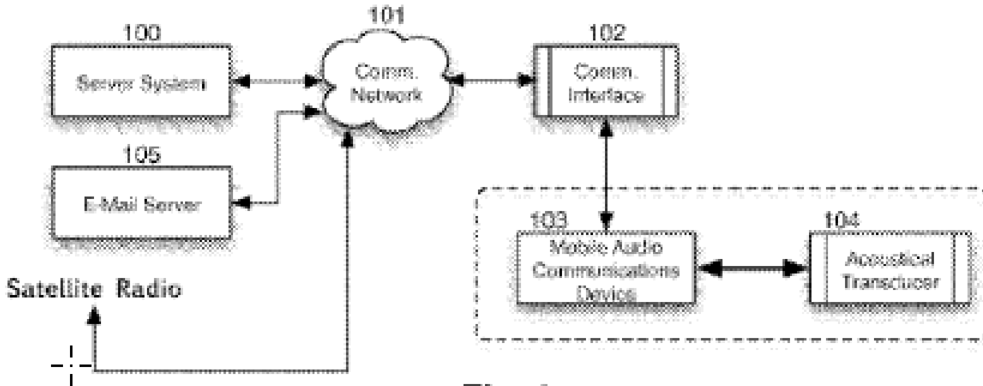


Fig. 1

Figure 1 illustrates the connection between earpiece device 103, 104 and Server system 100 and e-mail server 105, via a wired or wireless connection over communication network 101. *Id.* ¶¶ 6, 65.

3. *Independent Claim 1 and Dependent Claim 9*

Petitioner contends that the combination of Schrager and Goldstein would have rendered claims 1 and 9 obvious. Pet. 8–28. To support its arguments, Petitioner identifies certain passages in the cited references and explains the significance of each passage with respect to the corresponding claim limitation. *Id.* Petitioner also articulates reasons to combine the relied-upon aspects of Schrager and Goldstein with a reasonable expectation of success. *Id.* at 13–17. Patent Owner argues that claim 1 would not have been obvious. PO Resp. 15–20, 52–58 (asserting commercial success as indicating unobviousness of claim 1).

a) *Limitations of Claim 1 and Claim 9*

Petitioner contends that Schrager discloses that base unit 110 is a portable electronic device that includes CD player 155 or an MP3 player. Pet. 18–20 (citing Ex. 1101, 5:43–46, 6:10–12, 7:38–46; Ex. 1003 ¶ 113). Petitioner contends that Schrager's MP3 player is a digital audio player (DAP) as claimed. *Id.* at 19 (citing Ex. 1101, 2:16–21, 7:38–44; Ex. 1003

¶ 113). Petitioner also contends that Schrager's headset 105 is a headphone assembly with wireless transceiver communication circuit 135 that is separate from, and in wireless communication via Bluetooth and/or Wi-Fi, with base unit 110 (the MP3 player/DAP). *Id.* at 17 (citing Ex. 1101, 5:5–8, 7:21–28; Ex. 1003 ¶ 111), 21–22 (citing Ex. 1101, 5:64–6:4; Ex. 1003 ¶ 119; Ex. 1005 ¶ 165). In addition, Petitioner contends that Schrager's headset 105 includes all of the components of the headphone assembly recited in claim 1. *Id.* at 17–28.

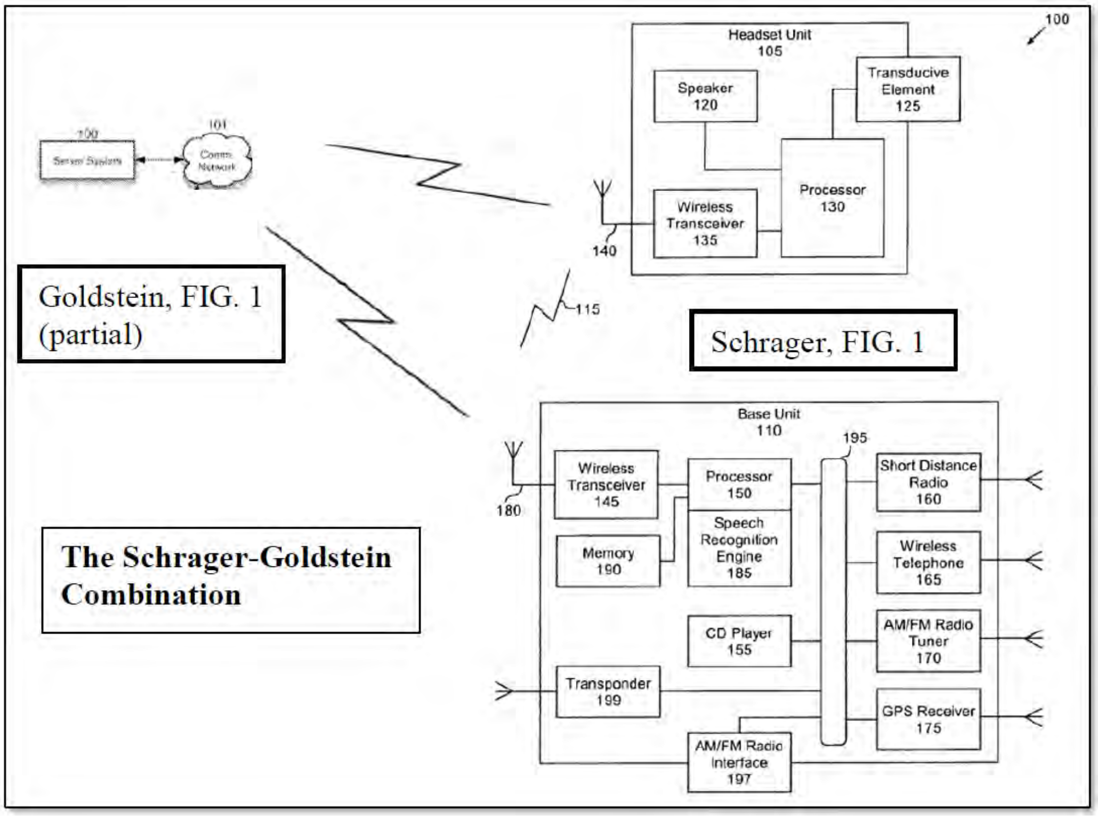
Regarding the claimed "network-connected server that is in wireless communication with the mobile, digital audio player" as recited in limitation 1J, Petitioner contends that the combination of Schrager and Goldstein suggests including Schrager's base unit 110 (the claimed DAP) in wireless communication with Goldstein's server system 100, which "is a 'remote, network-connected server,' as claimed, because it is a separate device that communicates over a remote communication network 101 (*e.g.*, Internet)." *See id.* at 26–27 (citing Ex. 1026 ¶¶ 65, 76–78; Ex. 1003 ¶ 132).

Regarding limitation 1K ("wherein the headphone assembly is for receiving firmware updates from the remote . . . server"), Petitioner contends that Goldstein's server provides "updates [*i.e.*, upgrades] to the firmware," and that it would have been obvious to include those updates for several reasons (e.g., to fix software bugs, as discussed further in the next section) to the headphone assembly of Schrager. *See id.* at 13–17 (asserting reasons to combine Schrager and Goldstein), 28 (quoting Ex. 1026 ¶ 82; citing Ex. 1026 ¶ 78; Ex. 1003 ¶¶ 133–135).

Claim 9 is similar to limitation 1K and recites that the "headphone assembly of claim 1 is for receiving firmware upgrades wirelessly." Petitioner refers to its showing for claim 1 and contends that "Schrager-

Goldstein's headphone wirelessly receives firmware upgrades from Goldstein's server 100." Pet. 31 (citing Ex. 1026 ¶¶ 78, 82; Ex. 1003 ¶¶ 148–149).

Petitioner provides an illustration, reproduced below, intended to depict the system resulting from the proposed combination of Schrager and Goldstein.



Pet. 16. The illustration above combines Figure 1 of Schrager on the right with a portion of Figure 1 of Goldstein (i.e., Goldstein's server system 100 and communication network 101) on the left, and shows Schrager's headset unit 105 and base unit 110 both in wireless communication with Goldstein's server system 100 and communication network 101.

b) Reasons to Combine

Assuming that claim 1 requires a wireless connection between the server and DAP, Petitioner argues that one of ordinary skill in the art would have "had reason to add Goldstein's PAA software to Schrager's headset and base unit so that each communicated with Goldstein's remote server to (1) purchase/download/stream audio files, and (2) obtain firmware updates, per Goldstein." Pet. 13 (citing Ex. 1003 ¶ 94). First, Petitioner supports this argument by adding that Schrager's system's "intended purpose . . . is to play audio content [such as music], and Goldstein provides a convenient way to control/stream/download/subscribe to/purchase music on a remote server offering a larger, updated content library compared to typical handheld devices." *Id.* (citing Ex. 1003 ¶ 95). Second, Petitioner argues that Goldstein teaches providing firmware updates to the headphone, and firmware updates had known benefits such as enhancing the headphone's functionality and security, accommodating new software parameters, and repairing coding errors. *Id.* at 13–14 (citing Ex. 1026 ¶¶ 19, 82; Ex. 1003 ¶ 96; Ex. 1019, 1:23–55) (describing a known "need to repair firmware coding errors and/or modify firmware functionality"), 19:40–57 (describing "securely upgrad[ing]" "wireless stereo headphones" "by means of a microcode download transmitted wirelessly from, for example, the Internet"). Third, Petitioner argues that the proposed combination would have yielded predictable results and would have improved Schrager's system by permitting the headset and base unit to obtain music and firmware from a remote server, as taught by Goldstein. *Id.* at 14 (citing Ex. 1003 ¶¶ 97–98).

c) Patent Owner's Arguments

Patent Owner argues that Petitioner failed to show that claim 1 would have been obvious. PO Resp. 15–21. According to Patent Owner,

"Petitioner failed to show that the firmware updates in Goldstein come from Goldstein's Server system, i.e., the server to which the request is transmitted according to Petitioner's argument for limitation [1J]." *Id.* at 16. According to Patent Owner's arguments, "Goldstein only mentions firmware updates once, at ¶[0082], and this lone reference is silent as to the source of the firmware updates." *Id.*

Patent Owner reproduces Goldstein's paragraph 82, as follows:

> In at least one exemplary embodiment a communications buffer is included. For example when a network connection is available, the communications buffer uploads stored content (e.g., Listening Habits Envelope) and stores incoming transmissions (e.g., music, electronic books, ***and updates to the firmware*** or operating system) from the Communications Port; The contents of the communications buffer are then transmitted whenever a network connection becomes available. At least one exemplary embodiment includes a perceptual audio codec decoding technology in the DSP [(digital signal processor)], enabling the storage and playback of compressed digital audio formats (e.g., MP3, MC, FLAC, etc.). At least one exemplary embodiment is compliant and compatible with DRM, FairPlay and other forms of digital content governance.

PO Resp. 16–17 (alteration in original) (quoting Ex. 1026 ¶ 82). Patent Owner adds similar arguments alleging that the source of any firmware upgrades is not from its server. *See id.* at 15–21. As an example, Patent Owner also alleges "it is not sufficient if any arbitrary server" in Goldstein performs "one or more of the features (i), (ii), and (iii), such as any server besides Goldstein's Server system, transmitting the firmware updates." *Id.* at 20–21 (asserting these three features are "(i) receive the request initiated from the headphone assembly; (ii) transmit the firmware upgrades for the headphone assembly; and (iii) be in wireless communication with the DAP"). As another example, citing the testimony of Mr. McAlexander,

Patent Owner argues that "a POSA would understand that the client computer in Goldstein provides the software download for the earpiece, and not the Server system." *Id.* at 18 (citing Ex. 2047 ¶¶ 40–41).

Regarding Patent Owner's features (i) (the server "receive[s] the request initiated from the headphone assembly") and (iii) (server "in wireless communication with the DAP"), they both relate to limitation 1J, "wherein the processor is configured to, upon activation of a user-control of the headphone assembly, initiate transmission of a request to a remote, network-connected server that is in wireless communication with the mobile, digital audio player." Assuming for the sake of argument that limitation 1J is not reciting an intended use of a server—and therefore, a server (which is not part of the claimed "headphone assembly") must receive the recited "request" and be "in wireless communication with a DAP"—Petitioner relies on the combined teachings of Schrager and Goldstein.[11]

Regarding feature (i), Petitioner contends that by using "Schrager's control buttons to operate Goldstein's PAA software," Goldstein's "'user control system allow[s] the user to purchase . . . content being auditioned in real time' and/or 'to control [or] . . . fast forward' the content being streamed from Goldstein's server system 100." Pet. 26 (alterations in original) (quoting Ex. 1026 ¶ 78; citing Pet. §§ VI.A.1.b–VI.A.1.c; Ex. 1026 ¶¶ 83–84; Ex. 1003 ¶ 130; Ex. 1005 ¶ 185). Petitioner adds that Goldstein's "user

[11] *See supra* § II.C (claim construction section noting that neither party shows how a "headphone assembly" requires connection to a server, which in turn is connected to the DAP, where a DAP and server are not part of the claimed "headphone assembly," and these external components "amount to limitations on the *structure of the headphone assembly*").

can also initiate a 'request [for] specific media content' on the server." *Id.* (citing Ex. 1026 ¶ 26).

Regarding feature (iii) (server in "wireless communication with the DAP"), Petitioner relies on the same or similar illustration and server for feature (i) as just described (*see also* Pet. 16, 27), and contends that it would have been obvious to connect Goldstein's server system 100 to Schrader's base unit 110 (the claimed DAP) in order to select and purchase music. *See* Pet. 13 ("Goldstein provides a convenient way to" "control[,] stream[,] download[,] subscribe to[, and] purchase music on a remote server offering a larger, updated content library compared to typical handheld devices"), 14–15 (arguing that it would have been obvious for Schrager's base unit (DAP) to include Goldstein's PAA buffer (memory) and software in order to communicate with and store music and other data from Goldstein's server), 26–27.

Although Patent Owner argues that "[i]t is not sufficient if any arbitrary server would perform one or more of the features (i), (ii), and (iii)" (PO Resp. 20), Petitioner does not rely on any arbitrary server. Rather, Petitioner relies on the same Goldstein server or server system 100 for all features (i), (ii), and (iii). *See* Pet. 13–28 (consistently relying on Goldstein's server system 100). Patent Owner does not address or challenge Petitioner's showing with respect to features (i) and (iii). For the reasons indicated above, Petitioner's showing as to these features is persuasive.

Regarding Patent Owner's arguments as to feature (ii) (server "transmit[s] the firmware upgrades for the headphone assembly"), it relates to limitation 1K, "wherein the headphone assembly is for receiving firmware upgrades transmitted from the remote, network-connected server." As summarized and outlined above, Patent Owner essentially argues that

Goldstein does not describe the source of firmware upgrades as Goldstein's server. *See* PO Resp. 15–20.

Assuming for the sake of argument that limitation 1K requires a server as part of the claimed "headphone assembly," Petitioner replies that Patent Owner "misinterprets Goldstein and disregards how POSAs would have implemented Schrager-Goldstein," where Petitioner relies on "more than Goldstein's express disclosure." Reply 2–3. Petitioner contends that Goldstein's paragraph 78 "says PAA-enabled devices have a 'Communications Port' that supports communication 'with the Server system,' and [paragraph 82] says the 'Communications Port' receives 'incoming transmissions' like 'updates to the firmware.'" *Id.* at 2 (citing (Ex. 1003 ¶¶ 96, 133; Pet. 28).

Petitioner's showing is persuasive. As Petitioner argues, Goldstein's PAA (Personal Audio Assistant), which is "within an earpiece (e.g., earbuds, headphones)" (Ex. 1026 ¶ 19), includes a "Communications Port . . . enabling communication with the Server system." *Id.* ¶ 78. And the Communications Port transfers "updates to the firmware" "when a network connection is available." *Id.* ¶ 80. Goldstein also states that "a communications network . . . connect[s] the Personal Audio Assistant to the Server." *Id.* ¶ 76. These passages suggest that the Schrader-Goldstein headphone assembly is "for receiving firmware updates transmitted from . . . the server" as claim 1 requires, because Goldstein's headphones "enabl[e] communication with the Server system," including "firmware" "updates" "when a network connection is available." *Id.* ¶¶ 78, 80.

Even though, as noted above, Patent Owner quotes Goldstein's paragraph 82 and acknowledges that Goldstein discloses storing "***updates to the firmware***" on a buffer using the "Communications Port" of the

headphone assembly "when a network connection is available," Patent Owner argues that "nothing in the paragraph identifies the source of the firmware." *See* PO Resp. 16 (alteration in original) (quoting Ex. 1036 ¶ 82). This line of argument isolates paragraph 82 and treats the disclosed "network connection" as distinct from a connection to Goldstein's Server System, which is on the network as Figure 1 shows. *See* Ex. 1026, Fig. 1 (showing connection between headphone assembly 103, 104 to "Server System 100" via communication network 101), ¶ 76. This argument also ignores Goldstein's teaching that the headphone assembly's "Communications Port" "enabl[es] communication with the Server system." *Id.* ¶ 78; *see also* Pet. 28 (citing Ex. 1026 ¶ 78).

The Petition also states that "[f]irmware updates received wirelessly from a server had known benefits, like adding 'performance enhancements . . . [to] accommodate new parameters not available at the time of distribution of the product' and repairing 'coding errors.'" Pet. 14 (quoting Ex. 1003 ¶ 96; citing Ex. 1019, 1:23–57) (second two alterations in original). The Petition also states that "[r]eceiving such updates wirelessly from a remote server also allowed the updates to be performed conveniently with minimal user-involvement." *Id.* (citing Ex. 1003 ¶ 96; Ex. 1019, 1:23–57). Petitioner adds that it would have been obvious to combine Schrager's headset and base unit (DAP) with Goldstein's server system 100 in order "to exchange digital data with a remote, network-connected server," and "[t]he combination would have improved Schrager's headset and base unit, by obtaining music and firmware from a remote-network server over the Internet, as Goldstein taught." *See id.*

The record supports Petitioner's showing that an artisan of ordinary skill would have implemented Goldstein's server system to exchange data

including firmware and music and implement the three features (i), (ii), (iii) noted by Patent Owner, from a single server or server system, using well-known communications protocols, for the reasons noted. *See* Pet. 13–17.

In other words, in addition to relying on specific disclosures in Goldstein, Petitioner relies on the knowledge of a person of ordinary skill in the art to show the obviousness of using Goldstein's server system to connect to Schrager's base unit (DAP) and headphones. *See* Pet. 16 (combining Goldstein's Fig. 1 with Schrager's Fig. 1 to produce a representation of the combined teachings). As Petitioner persuasively argues, "even if some unidentified device other than Goldstein's Server could transmit firmware updates to PAA-enabled devices, that critique "attack[s Goldstein] individually," rather than the Petition's ***combination***, which relied on more than Goldstein's express disclosure." Reply 3. As Petitioner also argues, "Goldstein 'at a minimum suggests using' its Server to transmit firmware." *Id.*

In addition, Petitioner persuasively shows that providing firmware updates "from a central server was known." Ex. 1146, 104:8–23 (Patent Owner's declarant conceding "it was known in general" to receive firmware updates from a remote server); Ex. 1160 ¶ 5. In other words, Petitioner persuasively shows that Goldstein discloses a single server or server system satisfying the limitations of claim 1, instead of what Patent Owner refers to as an "arbitrary server." *See* Reply 3; PO Resp. 20–21; Ex. 1160 ¶ 5 (testifying that "there is only one central server—Goldstein's Server" and "no 'other' server was identified for or added to the Schrager-Goldstein combination, i.e., there was only one server used in the combination—Goldstein's Server") (citing Ex. 1003 ¶¶ 94, 99–100).

Moreover, according to the ’934 patent specification, “[a]ny servers described herein . . . may be replaced by a ‘server farm’ or other grouping of networked servers (such as server blades) that are located and configured for cooperative functions.” Ex. 1001, 17:45–49. The challenged headphone assembly require the capability of receiving firmware upgrades from, and transmitting requests to, a server or networked group of servers. *See supra* § II.C (Claim Construction). The record does not support Patent Owner’s argument that Petitioner’s reliance on a single server is “a new argument.” Sur-reply 4. As noted above, the Petition consistently relies on Goldstein’s server system 100. Patent Owner’s related Sur-reply argument that the headphone assembly in the Goldstein-Schrager system “does not have to receive the firmware update from the same server to which the requests are sent” (*id.* at 6) ignores Petitioner’s showing based on the obviousness of implementing Goldstein’s server system 100.

Alternatively, the claimed headphone assembly need only have the capability to receive firmware updates from the same server to which the requests are sent. Nothing on this record indicates that any structure in the claimed headphone assembly would differ if it receives firmware updates from a different server than a server to which it sends requests versus if it receives firmware updates from the same server to which it sends requests.[12]

[12] As indicated above, the Board notified the parties in the Institution Decision that any structural limitations on the headphone assembly imparted by the server and DAP limitations is an issue of claim construction. *See supra* § II.C; Inst. Dec. 10–11 (noting that “neither party addresses how a processor configured to initiate the claimed transmission to a server is structurally different from the same processor configured to initiate the claimed transmission to the same server that is in turn connected wirelessly to a DAP”). Patent Owner agrees that the claims require that “the *processor is configured* . . . to initiate transmission of a request to a . . . server that is in

For the foregoing reasons, Petitioner's showing as to all the limitations of claims 1 and 9 as summarized above is persuasive and we adopt it as our own.

d) Summary

As detailed above, Petitioner shows that Schrager and Goldstein teach each limitation of claims 1 and 9, and that a skilled artisan would have had reasons to combined these references. As discussed in Section II.K below, Patent Owner's objective indicia of nonobviousness are unpersuasive and entitled to little weight. After considering all the evidence, including Patent Owner's objective indicia, we conclude that Petitioner shows by a preponderance of evidence that claims 1 and 9 would have been obvious over the combined teachings of Schrager and Goldstein.

4. Claims 2, 3, 5, 7, 10, and 11

Petitioner provides reasonable and detailed explanations, supported by the testimony of Dr. Williams and Dr. Casali, indicating how and why the combination of Schrager and Goldstein would have rendered claims 2, 3, 5, 7, 10, and 11 unpatentable. Pet. 28–33. Petitioner's showing is persuasive and we adopt and incorporate it as our own. *See id.* Other than its contentions regarding secondary considerations as discussed further below, Patent Owner offers no particular arguments with respect to these dependent claims.

As discussed in Section II.K below, Patent Owner's objective indicia of nonobviousness are unpersuasive and entitled to little weight. After considering all the evidence, including Patent Owner's objective indicia, we

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wireless communication with a mobile DAP" and that the "*headphone assembly is . . . for receiving* upgrades transmitted from the . . . server." PO Resp. 1–2.

conclude that Petitioner shows by a preponderance of evidence that claims 2, 3, 5, 7, 10 and 11 would have been unpatentable over the combination of Schrager and Goldstein.

5. Claims 32–37, 39, 47, and 49

Petitioner provides reasonable and detailed explanations, supported by the testimony of Dr. Williams and Dr. Casali, indicating how and why the combination of Schrager and Goldstein would have rendered claims 32, 33, 47, and 49 obvious. Pet. 33–37.

Based on our determination under Ground 2C that Petitioner shows claims 34–37 and 39 would have been obvious as outlined in Section II.1 below, we decline to reach claims 34–37 and 39 under Ground 1A here.

Claim 32 recites "[t]he headphone assembly of claim 1, wherein: the wireless circuit comprise first and second wireless circuits; the wireless circuit is in the first earphone; and the second wireless circuit is in the second earphone." Claim 33 recites "[t]he headphone assembly of claim 32, wherein each of the first and second earphones comprise earbuds."

Addressing claim 32, Petitioner contends that it would have been obvious to employ Goldstein's form factor teachings with Schrager's headphone teachings, in which one form factor includes an "intra-aural" (in-the-ear/in-the-canal design), so that "each earpiece has a wireless communication circuit . . . to receive 'signals.'" Pet. 34 (quoting Ex. 1026 ¶¶ 48, 66, Fig. 2; citing Ex. 1003 ¶ 159); *see also* Ex. 1026 ¶ 43 (describing an "intra-aural device" as including "completely in the canal (CIC), in the canal (ITC), in the ear (ITE), and behind the ear (BTE)"). According to Petitioner, putting a separate circuit in each earpiece "enable[s] a true-wireless design"—true-wireless earphones have no wire between the two earpieces. *See id.*; PO Resp. 6 (arguing that "earphones" without wires "are

sometimes called 'True Wireless' or 'TWS' earphones," and "TWS earphones are often implemented as earbuds (e.g., TWS earbuds)."). Petitioner adds that TWS earphones provide pleasing aesthetics and economic advantages based on allowing a user to replace only one earphone. *See id.* at 6 (citing Ex. 1003 ¶ 161; Ex. 1099 ¶ 41; Ex. 1005 ¶¶ 77–80; Pet. § VI.A.1.c), 17 (§ VI.A.1.c alleging unique benefits arising from selecting one of Goldstein's well-known form factors for use in Schrager's headset system, where Schrager discloses that its headset can embody different physical arrangements). Petitioner contends that "POSAs would reasonably have expected success in implementing Schrager-Goldstein in a true-wireless design because it required only ordinary skill to include Schrager's hardware in each earphone and apply the software needed to coordinate true-wireless earphones." Pet. 34–35 (citing Ex. 1003 ¶ 163).

Claim 33, depending from claim 32, and claim 49, depending from claim 1, each recite "wherein each of the first and second earphones comprise earbuds." Similar to its showing for claim 32, Petitioner contends it would have been obvious to "have used any of Goldstein's form-factors . . . including an 'intra-aural [*i.e.*, in-the-ear]' design . . . , which Goldstein's Figure 5A demonstrates as earbuds." Pet. 35 (second alteration in original) (quoting Ex. 1026 ¶ 48; citing Ex. 1003 ¶¶ 164–166, 183–184; Ex. 1005 ¶¶ 191–192; Pet. § VI.A.1.c), 17 (§VI.A.1.c alleging unique benefits arising from employing one of Goldstein's well-known form factors in Schrager's system, where Schrager discloses that its headset can embody different physical arrangements).

To support its showing, Petitioner reproduces Goldstein's Figure 5A, which follows:

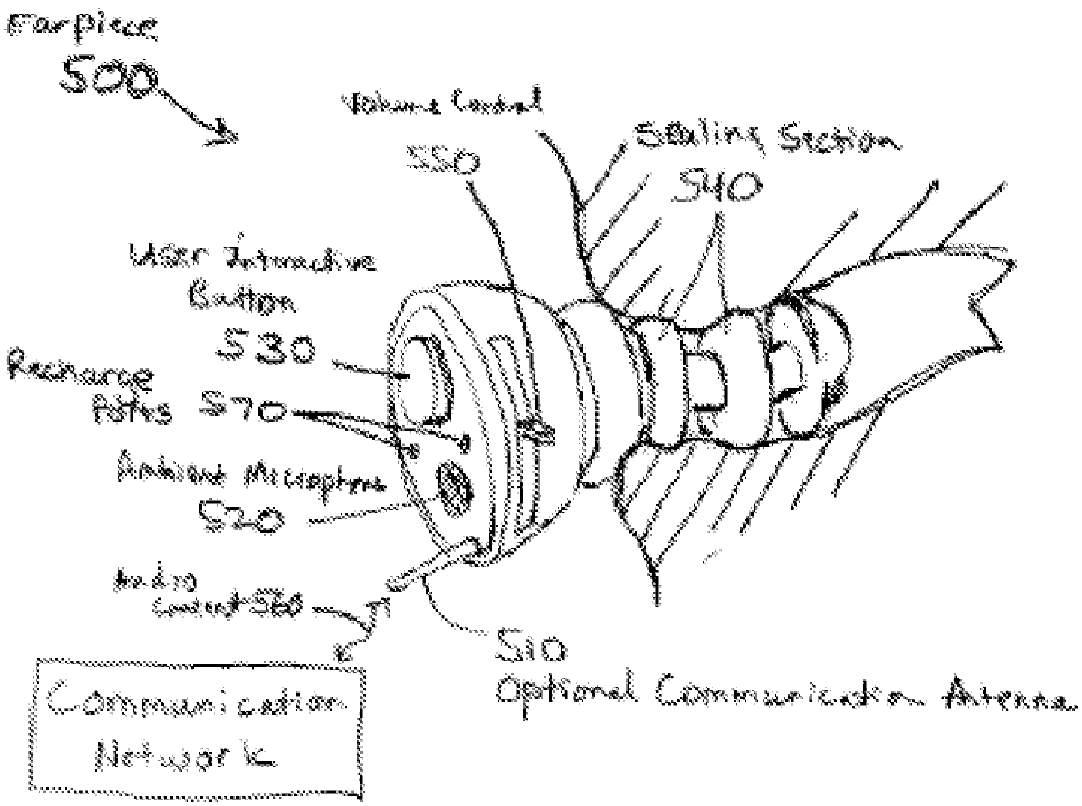

Figure 5A of Goldstein above illustrates a TWS earbud 500 partially mounted in the ear and ear canal of a user. *See* Ex. 1026 ¶¶ 69–70 (describing Fig. 5A). For the foregoing reasons and based on the discussion below of secondary considerations, Petitioner's showing, as summarized above, is persuasive to show that the combination of Schrager and Goldstein renders claims 32, 33, and 47 obvious.

As indicated above, the Petition also provides reasonable and detailed explanations, supported by the testimony of Dr. Williams, indicating how and why the combination of Schrager and Goldstein would have rendered claim 49 obvious. Pet. 35. Patent Owner does not provide separate arguments for claims 32, 33, 47, and 49. *See* PO Resp. 40.

As discussed in Section II.K below, Patent Owner's objective indicia of nonobviousness are unpersuasive and entitled to little weight. After

considering all the evidence, including Patent Owner's objective indicia, we conclude that Petitioner shows by a preponderance of evidence that Petitioner shows by a preponderance of evidence that claims 32, 33, 47, and 49 would have been unpatentable over the combination of Schrager and Goldstein.

As noted above, we decline to reach claims 34–37 and 39 under Ground 1A here and address these claims in Section II.I below.

6. Claims 52–57

Petitioner provides reasonable and detailed explanations, supported by the testimony of Dr. Williams and Dr. Casali, indicating how and why the combination of Schrager and Goldstein would have rendered obvious claims 52–57. Pet. 33–37. Patent Owner responds that claims 56 and 57 would not have been obvious. PO Resp. 43–47.

Claims 52 follows: "The headphone assembly of claim 1, wherein the processor comprises a digital signal processor that provides a sound quality enhancement for the audio content played by the acoustic transducers."

Addressing claim 52, Petitioner contends that "Schrager-Goldstein includes Schrager's 'processor 130' (brown), which 'can be embodied as . . . ***digital signal processing*** (DSP) units.'" Pet. 38 (alteration in original) (quoting Ex. 1101, 5:33–34, 5:55–58; citing Ex. 1003 ¶ 120). Petitioner contends that Schrager's "processor 130 'perform[s] a variety of audio processing,' including 'digital-to-analog (D/A) conversions of audio . . . provide[d] . . . to the speaker,' which is a 'sound quality enhancement for the audio content played by the acoustic transducers,' as claimed." *Id.* at 39 (citing Ex. 1003 ¶ 189; Ex. 1005 ¶¶ 95, 186). Petitioner also contends that "[u]sing a DSP to enhance playback sound quality (*e.g.*, noise cancellation/equalization) was also conventional and taught by Goldstein

. . . , thus motivating POSAs to include those enhancements in Schrager-Goldstein's headset to achieve their well-known benefits." *Id.* (citing Ex. 1026 ¶¶ 90–91; Ex. 1003 ¶¶ 99–103, 190–191; Ex. 1136 ¶¶ 5–7; Ex. 1137 ¶¶ 5–6; Ex. 1005 ¶¶ 186, 193; Pet. § VI.A.1.d(5)). As indicated above, Patent Owner does not present separate arguments for claim 52. *See* PO Resp. 43–47.

Claims 53–57 follow:

> 53. The headphone assembly of claim 52, further comprising a baseband processor circuit that is in communication with the wireless communication circuit.
>
> 54. The headphone assembly of claim 1, wherein each of the first and second earphones comprise: an antenna for receiving wireless signals from the mobile, digital audio player via the one or more ad hoc wireless communication links; a wireless communication circuit connected to the antenna, wherein the wireless communication circuit is for receiving and transmitting wireless signals to and from the headphone assembly; a processor; a memory for storing firmware that is executed by the processor; and a rechargeable battery for powering the headphone assembly.
>
> 55. The headphone assembly of claim 54, wherein each of the first and second earphones comprise an earbud.
>
> 56. The headphone assembly of claim 55, wherein the processor of each of the first and second earphones comprises a digital signal processor that provides a sound quality enhancement for the audio content played by the acoustic transducer of the earphone.
>
> 57. The headphone assembly of claim 56, wherein the processor of each of the first and second earphones comprises a baseband processor circuit that is in communication with the wireless communication circuit of the earphone.

Addressing claim 53, Petitioner explains that Schrager's processor 130 "can be 'embodied as one or more processors, including control processors' (Schrager, 5:54–58), which POSAs understood included

baseband processing of digital data according to, e.g., Bluetooth/Wi-Fi standards because processor 130 is an 'interface' to the wireless (Bluetooth/Wi-Fi) communication circuit (Schrager, 5:31–36)." Pet. 40 (citing Ex. 1101, 5:31–36, 5:54–58); Ex. 1003 ¶ 194; Ex. 1039 ¶¶ 21–23; Ex. 1138 ¶¶ 27–28). Petitioner contends that even if Schrager's processor does not perform baseband processing, "it would have been conventional and preferred to include baseband processor circuitry because of the advantages over non-baseband processing (e.g., allowing for DSP-based sound enhancements . . .)." *Id.* (citing Ex. 1003 ¶ 195).

Addressing claim 54, Petitioner explains that the combination of Schrager and Goldstein renders obvious storing the claimed components in each earphone in order to achieve the benefits of true wireless (TWS) design. Pet. 41 (citing Ex. 1101, 5:5–8, 7:24–26, 8:65–9:5; Ex. 1026 ¶ 82; Ex. 1003 ¶ 197; Ex. 1005 ¶ 47).

Addressing claims 55–57, Petitioner relies on its showing for claims 33, 52, and 53, contending claims 55–57 would have been obvious for the same reasons as claims 33, 52, and 53, explaining as follows:

> Claim 55 depends from claim 54, and adds the limitation claim 33 added to claim 32 (for each earphone); claim 56 depends from claim 55, and adds the limitation claim 52 added to claim 1 (for each earphone); claim 57 depends from claim 56, and adds the limitation claim 53 added to claim 52 (for each earphone).

Pet. 41 (citing Pet. §§ VI.A.1.l, VI.A.1.r, VI.A.1.s; Ex. 1003 ¶¶ 198–203).

In addition to the limitations of claim 1, dependent claim 56 requires each "earbud" of claim 55 to include "an antenna . . . , a wireless communication circuit . . . , a processor, a memory . . . , and a rechargeable battery" as claim 54 recites, wherein each "processor . . . comprises a [DSP]

that provides a sound quality enhancement for the audio content played by the acoustic transducer of the earphone." So essentially, claim 56 includes TWS earbuds wherein each earbud includes the circuitry noted including a DSP for providing "sound quality enhancement for the audio content played by the acoustic transducer of the earphone."

As indicated above, Patent Owner does not present separate arguments for claims 53–55 and 57. *See* PO Resp. 43–47. Rather, Patent Owner advances three central reasons as to why claim 56, and claim 57, which depends from claim 56, would not have been obvious. *See id.*; Reply 22 n.5 ("The DSP claims are claims 52 and 56 (and their dependents), but [Patent Owner] only challenges [Petitioner]'s showing for claim 56, which (unlike claim 52) covers true wireless earbuds." (citing PO Resp. 44)). In the first two arguments, Patent Owner contends that Schrager's DSP would not perform digital to analog (D/A) or analog to digital (A/D) conversion, so the record does not support Petitioner's argument that D/A conversion is a sound quality enhancement performed by a DSP. *See* PO Resp. 44–46. Third, Patent Owner argues that "Goldstein does not disclose that the earbud shown in Goldstein's Figure 5A includes such a DSP," and "claim 56 is limited to TWS earbuds." *Id.* at 46. Patent Owner concludes that "neither Casali nor Williams explained why it would have been obvious for a POSA to implement a DSP in each TWS earbud given the small form factor of an earbud." *Id.* at 47. Patent Owner also argues that claim 56 would not have been obvious because of the high heat generated by DSPs, creating "a challenge for a POSA to include a DSP in an earbud along with the other requirements of a wireless earbud." *See id.* at 50–51.

These arguments do not undermine Petitioner's showing because they largely attack the reference teachings individually, mischaracterize

Goldstein's DSP teachings, and do not account for the knowledge of an artisan of ordinary skill. Petitioner shows that that Schrager discloses a DSP in earphones and that DSPs generally were known for processing digital sound signals including noise cancellation or other sound quality techniques. *See* Pet. 40 (citing Ex. 1101, 5:31–36, 5:54–58; Ex. 1003 ¶ 194; Ex. 1039 ¶¶ 21–23; Ex. 1138 ¶¶ 27–28); Ex. 1003 ¶¶ 190, 195. Patent Owner acknowledges that Dr. Casali testifies "that by 2008, active noise cancellation was 'often implemented' in over-the-ear headphones that had 'earcups.'" PO Resp. 47 (citing Ex. 1005 ¶¶ 58, 95, 106). Patent Owner also acknowledges that "Goldstein discloses that an 'earpiece' could include a DSP ([Ex. 1026 ¶ 67, Fig. 3]), and that the DSP can attenuate and mix different signals (*id.*, ¶[0091])." *Id.* Patent Owner characterizes "Dr. Casali's observation" (Ex. 1005 ¶ 58) as "circa 2008, DSP[s] for active noise cancellation were only 'often implemented' in over-the ear headphones that had earcups, not in TWS earbuds." *Id.* at 48 (citing Ex. 2047 ¶ 76).

Patent Owner does not dispute that Goldstein teaches sound quality enhancement in its Response. *See* PO Resp. 47–48 (alleging Goldstein does not disclose an earbud with a DSP). Patent Owner's Sur-reply introduces a new argument, namely that "*Goldstein does not disclose* that the logic circuit in the Figure 5A embodiment, even if it includes a DSP, performs *a sound quality enhancement*." Sur-reply 19 (emphasis added). This argument is untimely and waived. Moreover, even if timely, as Petitioner also argues, "[Patent Owner] does not dispute that using DSPs for sound-quality enhancements, like noise cancellation, was 'conventional' and had 'well-known benefits'" in earphones. Reply 23 (citing Pet. 39). In addition, the Petition shows that "POSAs would have implemented Schrager-Goldstein's

earbuds such that each uses Schrager's DSPs to 'enhance playback sound quality such as noise cancellation and/or equalization because such functionality was conventional and desirable.'" *Id.* at 22 (quoting Pet. 39 (citations omitted); citing Ex. 1003 ¶ 101 (testifying that "by 2008 . . . active noise cancellation techniques . . . were commonly implemented using" DSPs and that DSPs also "were being used to enhance stereo-sound playback" (citing Ex. 1136 ¶¶ 5–6; Ex. 1137 ¶¶ 5–6)). The record supports Petitioner's showing that DSPs commonly implemented noise cancelation techniques to enhance stereo-sound playback. *See* Ex. 1003 ¶¶ 100–101 (describing prior art noise cancellation techniques); Ex. 1136 ¶¶ 5–7 (describing a DSP for noise cancellation as background art); Ex. 1137 ¶¶ 4–6 (describing DSPs as inexpensive means for enhancing sound via surround sound techniques as prior art).

As Petitioner also argues, Goldstein's "logic circuit 570," implemented in the block diagram of Figure 5B as circuitry in the TWS earbuds of Figure 5A, includes "DSP code 330" (Ex. 1026 ¶ 67), indicating a DSP as part of logic circuit 570 for TWS earbuds, contrary to Patent Owner's arguments. *See id.* ¶¶ 67, 69, 70; Reply 24 ("As seen in Figure 5B, the Figure 5A earbud has a 'logic circuit 570,' which Goldstein's [0067] says includes a DSP." (citing Ex. 1026 ¶ 67, Figs. 5A, 5B)). Oh's earbuds also employ DSPs, a battery, and other earbud circuitry, contradicting Patent Owner's argument (and the similar testimony of Mr. McAlexander) that high heat of DSPs present a challenge and the related argument that it would not have been obvious "for a POSA to implement a DSP in each TWS earbud given the small form factor of an earbud." *Compare* PO Resp. 47 (citing Ex. 2047 ¶¶ 74–75 (testifying that heat from a large battery to supply a DSP would be "undesirable to a POSA designing wireless earbuds")), *with infra*

§ II.I.1 (discussing Oh's teachings); Pet. 87–89 (similar); Ex. 1099 ¶ 44 (discussing Oh's earbuds and DSP); Reply 32 (arguing that Patent Owner "concedes Oh (Ex. 1099) and Goldstein (Ex. 1026) are prior art that disclose true-wireless earphones." (citing PO Resp. 8–11; Ex. 1160 ¶¶ 79–82)). As Petitioner also argues, Patent Owner does not "challenge [Dr. Williams'] testimony that POSAs would have expected success in the combination." Reply 23 (citing Ex. 1003 ¶ 103).

As summarized above, after considering the full record, including alleged secondary indicia of nonobviousness, Patent Owner's arguments do not undermine Petitioner's showing. Petitioner persuasively shows that it would have been obvious in view of the combined teachings and knowledge of an artisan of ordinary skill to implement a DSP in truly wireless earbuds and other earphones in order to provide better sound quality in audio playback, where there is no dispute that using DSPs in earphones for that purpose generally was well-known and using earbud DSPs to implement audio enhancement including noise cancellation (albeit not necessarily in audio playback as claimed) also generally was well-known.

As discussed in Section II.K below, Patent Owner's objective indicia of nonobviousness are unpersuasive and entitled to little weight. After considering all the evidence, including Patent Owner's objective indicia, we conclude that Petitioner shows by a preponderance of evidence that claims 52–57 would have been unpatentable over the combination of Schrager and Goldstein.

E. Ground 1C, Claims 14–16, 19, 21, and 49–51

Petitioner challenges claims 14–16, 19, 21, and 49–51 as unpatentable under 35 U.S.C. § 103(a) based on Schrager, Goldstein, and Skulley (Ground 1C). Pet. 47–49. The Petition provides reasonable and detailed

explanations, supported by the testimony of Dr. Williams and Dr. Casali, indicating how and why these claims would have been obvious. Pet. 47–49. Petitioner's showing for claims 14–16, 19, 21, and 49–51 is persuasive and we adopt it and incorporate it as our own. *See* Pet. 47–49. Patent Owner does not provide separate arguments for these claims. *See generally* PO Resp.

As discussed in Section II.K below, Patent Owner's objective indicia of nonobviousness are unpersuasive and entitled to little weight. After considering all the evidence, including Patent Owner's objective indicia, we conclude that Petitioner shows by a preponderance of evidence that claims 14–16, 19, 21, and 49–51 would have been unpatentable over the combination of Schrager, Goldstein, and Skulley.

F. Grounds 1B and 1D, Claims 4, 6, 8, 12, 13, 17, 18, 20, 22, 38, 40, 41, and 58–62 ("Signal Strength" Claims)

The parties refer to claims 4, 6, 8, 12, 13, 17, 18, 20, 22, 38, 40, 41, and 58–62 as the "Signal Strength claims." PO Resp. 26–29; Reply 10–14. Claim 4 is representative of the Signal Strength claims and is reproduced below, with bracketed numbering added to track those used in the Petition:

> 4. The headphone assembly of claim 3, wherein:
>
> [4A] the mobile, digital audio player is a first digital audio source;
>
> [4B] the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

Petitioner relies on the additional teachings of Harada and alleges that claims 4, 6, 8, 12, 13, 38, 40, 41, and 58–62 would have been obvious over Schrager, Goldstein, and Harada (Ground 1B); and claims 17, 18, 20, and 22 would have been obvious over Schrager, Goldstein, Skulley, and Harada (Ground 1D). Pet. 42–50.

1. Harada

Harada discloses a "dynamic priority connection system" (Ex. 1098 ¶ 78) for "any device[] equipped with [a] short-range wireless communication function" to "connect with a device having the highest availability" (*id.* ¶ 23). "As a specific example, the present invention relates to an emergency transmission of an electronic device such as a cellular phone and contributes to the improvement of the credibility of the emergency transmission by selecting an optimum device from surrounding communication devices to utilize the communication function thereof." *Id.* ¶ 12. Figure 1 of Harada, reproduced below, illustrates an example:

FIG.1

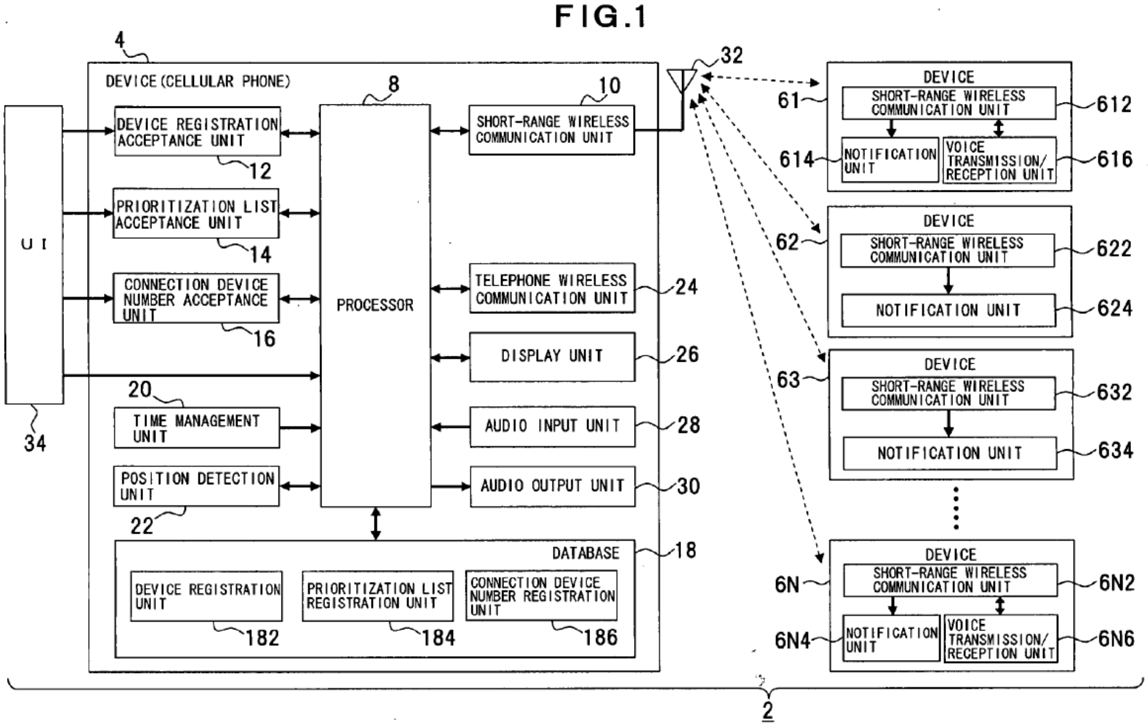

Figure 1 is a block diagram of an inter-device priority connection apparatus, specifically, dynamic priority connection system 2. *Id.* ¶¶ 33, 66–67.

Electronic device 4, e.g., a cellular phone, includes a short-range wireless communication function, such as Bluetooth.[13] Ex. 1098 ¶ 67. Devices 61–6N include the same communication function, are connectable with cellular phone 4 using the communication function, and can be, for example, cellular phones, personal computers, television sets, automobiles, watches, or GPS apparatus. *Id.* ¶¶ 67, 70. Device registration acceptance unit 12 accepts registration functions from devices 61–6N as connection destination devices, and prioritization list acceptance unit 14 "accepts a prioritization list dependent on information such as position, time, etc. and a prioritization list not dependent on information such as position, time, etc." *Id.* ¶ 71.

In operation, short-range wireless communication unit 10 monitors received signal levels from the devices of devices 61–6N that are registered. Ex. 1098 ¶ 78.

> If the registered device is a cellular phone, by synchronizing the communication with the cellular phone and performing communication and by having the cellular phone notify the electronic device of a received signal level from a base station of the cellular phone, a remaining battery power amount of the cellular phone and a phone call status, the received signal level, the remaining battery power amount and the phone call status of the registered cellular phone can be managed.

Id. In one example of cellular phone 4 connecting to one or more of devices 61–6N:

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[13] Figure 15 of Harada (not shown), is similar to Figure 1, but shows electronic device 60, a device other than a cellular phone, rather than cellular phone 4. *Id.* ¶¶ 145–147, Fig. 15.

> the connection can be achieved with the device with the highest received signal level by monitoring the received signal level of the short-range wireless communication. As an example, if the registered devices are cellular phones, by having the cellular phones notify of a received signal level from a base station of the cellular phone, a remaining battery power amount of the cellular phone and a phone call status, the cellular phones having the remaining battery power amount and not in a phone-calling status are selected and the connection can be achieved with a cellular phone among those cellular phones, which has the highest received signal level from the base station.

Id. ¶ 85. Cellular phone 4 reads the device addresses of the devices of 61–6N that are registered; connects with those devices through the short-range wireless communication unit; receives signal level, battery level, and call status from each connected device; and connects with one or more of the devices that have a high priority (if the devices are prioritized), enough battery power, and are not already on a call. *Id.* ¶¶ 109–111, Fig. 9.

Harada gives several examples of how its system might be used. In one example, cellular phone 4 sends a textual message to one or more of a television, refrigerator, navigation apparatus, watch, and laptop computer indicating that mail has been received, each of which displays the message. Ex. 1098 ¶¶ 196–210, Fig. 27. In another example, cellular phone 4 sends a scheduling message to one or more such devices, which display the scheduling message. *Id.*¶¶ 211–224, Fig. 28. In another example, a connected device (e.g., a notebook computer or a watch) can change a set mode (e.g., silent mode) of cellular phone 4. *Id.* ¶¶ 225–228, Fig. 29. In another example, one or more devices, in an order of priority (e.g., a laptop computer from work or a watch from outside work) can send a text mail message to cellular phone 4 (e.g., "I'm coming home now"). *Id.* ¶¶ 229–232, Fig. 30. In another example, cellular phone 4 sends an emergency

notification to one or more cellular phones, connecting based on received signal levels, remaining battery power, and phone call status of the cellular phones. *Id.* ¶¶ 233–237, Fig. 31.

2. *Signal Strength Claims*[14]

Petitioner contends that Schrager's base unit 110 is "the mobile, digital audio player" recited in claim limitation [4A] as "a first digital audio source." Pet. 45. Petitioner further contends that Harada teaches a "technique to automatically transition from playing digital audio content (e.g., music) received from the base unit to 'play[ing] digital audio content received wirelessly from' Goldstein's server or another headphone assembly (or cellular phone or MP3 player) via a 'second wireless communication link' 'based on, at least, the signal strength level for the' 'communication link' to the second source, as claimed" in limitation [4B]. *Id.* at 45–46 (citing Ex. 1098 ¶¶ 16, 23, 78, 85, 145–147; Ex. 1003 ¶¶ 217–218) (alteration by Petitioner). Petitioner contends that Harada teaches receiving audio from multiple sources and that its technique of switching among those audio sources would have been applicable to the audio sources of Goldstein and Schrager. *Id.* at 43–44 ("like Harada's device, Schrager-Goldstein's headset has multiple audio sources from which to receive audio [and] would have provided Schrager-Goldstein's headset a technique to connect to an alternative audio source" (citing Ex. 1098 ¶¶ 16, 20, 31)); *see also id.* at 83 ("Harada taught a technique for selecting among audio-source based on received signal strength."); Ex. 1003 ¶ 210 ("Harada taught a technique for a

[14] As indicated in the case caption above, *Administrative Patent Judge* McKone is the author of this "Signal Strength" section, with whom *Administrative Patent Judge* Scanlon joins. *Administrative Patent Judge* Easthom dissents as to this section as indicated above and below.

device to select among audio-sources based on received signal strength." (citing Ex. 1098 ¶¶ 16, 23, 78, 85, 145–147)). Specifically, Petitioner contends that Harada's teaching would have provided a technique for connecting to alternative audio sources when a connection to a previous audio source was lost or became poor, such as switching to Goldstein's server when Schrager's base unit traveled out of range of the headset or Schrager's base unit's battery died. Pet. 43–44 (citing Ex. 1003 ¶¶ 210–211).

Petitioner argues that Harada's technique would have been a known technique that would have improved the system of Schrager and Goldstein in the same manner, "e.g., by enhancing the device's connection to audio sources and/or identifying alternative sources based on signal strength when another's battery died." Pet. 44 (citing Ex. 1003 ¶ 212). Petitioner contends that a skilled artisan would have had a reasonable expectation of success in light of Harada's teaching that its technique could be applied to any device equipped with a short-range wireless communication function. *Id.* (citing Ex. 1098 ¶¶ 23, 145–147; Ex. 1003 ¶ 213).

We are not persuaded by Petitioner's arguments and evidence. Petitioner does not show that Harada teaches playing digital audio content received from multiple sources. Harada's paragraphs 16, 78, and 85 describe selecting a connection destination device by the received signal strength of the short-range wireless signal or remaining battery life; paragraph 23 lists possible electronic devices, such as cellular phones, personal computers, and watches; and paragraphs 145–147 make clear that the cellular phone 4 of Figure 1 could be other devices, such as an information processing terminal or household electric device. We do not

read these paragraphs as describing a cellular phone (or other device) receiving digital audio content from multiple digital audio content sources.

At best, paragraph 85 states that "[w]ith such a connection form, the credibility of the connection can be improved and the intelligibility of the phone call can be enhanced." Petitioner cites to, but does not explain, its reliance on paragraph 85. Pet. 42, 45–46; Ex. 1003 ¶¶ 210, 217. Paragraph 85 provides a general teaching of connecting to one or more registered devices, which may be cellular phones, based on signal level, battery power, and phone call status. Ex. 1098 ¶ 85. Even if this can be read to teach receiving digital audio content from a cellular phone (which is not taught clearly), it does not teach transitioning from one digital audio source to another. In fact, Harada's examples suggest that transitioning from audio source to audio source is not contemplated. Rather, as detailed above, Harada's examples are directed to broadcasting a text-based message from a cellular phone to multiple devices or using one such device to reconfigure or send a text-based message to the cellular phone. *Id.* ¶¶ 196–237, Figs. 27–31. We do not find that Harada is limited to those examples. However, Harada does not include the teaching on which Petitioner bases its reliance on Harada, namely, a technique for transitioning from playing digital audio content from one source to playing digital audio content from another

source.[15] Pet. 43–44, 45–46. This claimed feature is missing from the Schrager-Goldstein combination and is not found in Harada.

In the Dissent's view, Petitioner shows that Harada's technique simply automates receiving a signal from a registered source, which could be any device, before losing the signal from another registered source. The audio sources would be taught by Schrager and Goldstein. Under the Dissent's view, then, Petitioner's combination could be said to rely on Goldstein and Schrager for playing digital audio content from more than one device (e.g., Goldstein's server and Schrager's server, Pet. 45), with Harada merely supplying a transition from one generic electronic device to another based in part on signal strength. This is not the combination Petitioner presented in the Petition, as detailed above. But even if it were, it would not be persuasive or supported by evidence.

First, Petitioner does not identify where Harada teaches transitioning from one generic data source to another. Petitioner's citations (Pet. 42–46 (citing Ex. 1098 ¶¶ 11, 14–16, 20, 23, 25, 31, 78, 85, 145–147)) at most show selecting one or more devices to connect to, from a set of registered devices, based on factors such as registered priority, signal strength, and remaining battery power. In one instance, Harada states that one device might be "concurrently connected" to multiple other devices (Ex. 1098

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[15] If Petitioner contends that Harada merely teaches selecting a source, rather than transitioning from a first source to a second source, then Petitioner has not alleged (or proved) that any reference teaches transitioning to play content received from a second source. Petitioner cites neither Goldstein nor Schrager for a teaching of transitioning. *See* Pet. 45–46 (citing Harada, Ex. 1098 ¶¶ 16, 23, 78, 85, 145–147 for claim limitation [4B]). Dr. Williams (Ex. 1003 ¶ 217) merely copies the argument from the Petition, without adding to it materially. Thus, his testimony on this point is unhelpful and is entitled to little weight.

¶ 20), but none of Petitioner's citations show a cellular phone (or other device) starting with a connection to a first device and transitioning to a connection to a second device.[16] Thus, even under a more generous reading of Petitioner's combination, Harada still does not teach the transitioning that is missing from the combination of Goldstein and Schrager.

Second, we find that Petitioner has not articulated a reason, with rational underpinning, to combine Goldstein and Schrager with a generic teaching of transitioning from one source to another. Petitioner's stated reason for combining the teachings is that "it would have been using a known technique (Harada's device-selection technique) to improve a similar electronic device in the same way (e.g., by enhancing the device's connection to audio sources and/or identifying alternative sources based on signal strength when another's battery died)." Pet. 44 (citing Ex. 1003 ¶ 212). Assuming that Harada teaches that it is possible to transition from one device to another, the evidence still does not support a finding that transitioning from one audio source to another based on the relative strengths of the signals received from the two sources would have been an

[16] The Dissent would rely on Petitioner's Reply argument that "Figure 8 [of Harada] discloses switching based on signal strength between a device and destination devices." Reply 13 (citing Ex. 1098 ¶¶ 103–107, Fig. 8 (step S28)). Petitioner does not argue or cite to Figure 8 in the Petition. In any case, Petitioner does not explain how Figure 8, step S28, shows transitioning from a lost or weak connection (or one with a low battery) to a stronger connection, as opposed to selecting one or more devices it has connected to in step S22 (for purposes of evaluating those connections) and dropping the rest.

improvement.[17] Petitioner's evidence in support of this point is no more than conclusory testimony of Dr. Williams (Ex. 1003 ¶ 212), which we do not find credible on this point.[18]

For the first time at the oral argument, Petitioner argued that

> H[a]rada's technique would apply in the use case of a headphone where you walk around and you might go from one device that you're connected to with audio. You might lose that one and you want to pick up another one so that you can maintain the ability to get audio, even if it's not the exact same audio transmission.

Tr. 99:20–100:1. In the Dissent's view, the combined system is agnostic as what audio information the device transitions to, whether it be the same audio or something different entirely. To the extent that this new argument even should be considered (despite the Dissent's argument to the contrary, it should not be, because it was not presented in the Petition or Reply), it is not supported by evidence in the record. For example, Petitioner does not point

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[17] We recognize that the Supreme Court has articulated other reasons, besides an improvement, that could support a conclusion of obviousness. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415–418 (2007); *see also Mouttet*, 686 F.3d 1322, 1334 (Fed. Cir. 2012) ("This court has further explained that just because better alternatives exist in the prior art does not mean that an inferior combination is inapt for obviousness purposes."). Here, however, Petitioner expressly relies on the improvement Harada allegedly provides to improve the electronic devices of Goldstein and Schrager in the same way. Pet. 44. Because Petitioner has not shown that Harada's technique would improve Goldstein and Schrager, Petitioner has not supported its primary stated reason to combine Harada with Goldstein and Schrager.

[18] Petitioner also points to disclosure in Harada that its technique would "improve" "convenience for the user." Pet. 43 (quoting Ex. 1098 ¶¶ 20, 31). This description, however, explains the benefit of the ability to maintain concurrent connections, not the benefit of transitioning from one connection to another. Ex. 1098 ¶ 20. Thus, Petitioner has not explained persuasively why this disclosure supports its proposed combination.

to any description in Harada that, if a device experiences a lack of a connection or a dropped connection, then the device should connect to something else. Rather, Petitioner's combination is an improvement only in hindsight.

Moreover, it is not clear (even in hindsight) why transitioning from one audio source to another as a user walks from place to place would be an improvement. For example, it might be disorienting and undesirable to switch from a cellular telephone to a music-playing device when the signal from the music-playing device becomes stronger. Likewise, transitioning from a music-playing device to a television when moving from one room in a house to another might be seen as disadvantageous, at least in the absence of hindsight. Neither the Petition nor Dr. Williams specifies why the behaviors they expect would result from their combinations would have been improvements. Replacing dead air with an arbitrary replacement audio signal might be desirable, or it might not—the evidence of record does not say. The Dissent observes that the Signal Strength claims are broad enough to cover transitioning from one digital audio source to another even if it would have been disorienting. Even if that is true, Petitioner has not offered persuasive evidence of whether the result of the transitions proposed under its new theory would be desirable or disorienting or why such a result (even if disorienting) would have motivated its combination.[19] Petitioner has not

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[19] The Dissent argues that Patent Owner's infringement contentions allege automatically switching between music and different audio an incoming phone call, and likens this to Harada's device moving out of range of one device and switching to another. Patent Owner's infringement contentions do not purport to be evidence of what a skilled artisan would have known at the time of the invention; thus, we find them of little relevance.

articulated a reason, with rational underpinning, to combine Goldstein and Schrager with Harada.

The Dissent offers another example of a car radio transitioning from one radio station to another of the same frequency when the car becomes closer to the new station and farther from the first. However, Petitioner (who does not advance this argument) does not offer evidence that this is a desirable result or why it would have been applicable to its proposed combination of Goldstein and Schrager with Harada. We do not find that it provides a reason to make Petitioner's combination.

In sum, because Harada does not supply the limitation missing from Goldstein and Schrager (either under the combination proposed in the Petition or the Dissent's broader reading of that combination) and because Petitioner has not articulated a reason, with rational underpinning, to combine Goldstein and Schrager with Harada, Petitioner has not proved, by a preponderance of the evidence, that claims 4, 6, 8, 12, 13, 38, 40, 41, and 58–62 would have been obvious over Goldstein, Schrager, and Harada, or that claims 17, 18, 20, and 22 would have been obvious over Goldstein, Schrager, Skulley, and Harada.

G. Ground 2A: Rezvani-446, Rezvani-875, Skulley, and Hind

Petitioner asserts that claims 1–3, 5, 7, 9–11, 14–16, 19, 21, 47, and 49–53 are unpatentable under 35 U.S.C. § 103(a) based on Rezvani-446, Rezvani-875, Skulley, and Hind. Pet. 51–82. Patent Owner disagrees. PO Resp. 21–26, 52–61 (alleging commercial success); Sur-reply 6–8, 23–24.

1. Rezvani-446

Rezvani-446 relates to providing content to wireless portable media (WPM) clients by creating a wireless link between the WPM clients and a WPM server. Ex. 1097 ¶ 4. In one embodiment, the system includes WPM

server 402 and headset 404 as the sole WPM client. *Id.* ¶ 55, Fig. 4. A user of headset 404 requests music files across a wireless link to WPM server 402. *Id.* ¶ 55.

Figure 7 of Rezvani-446 follows:

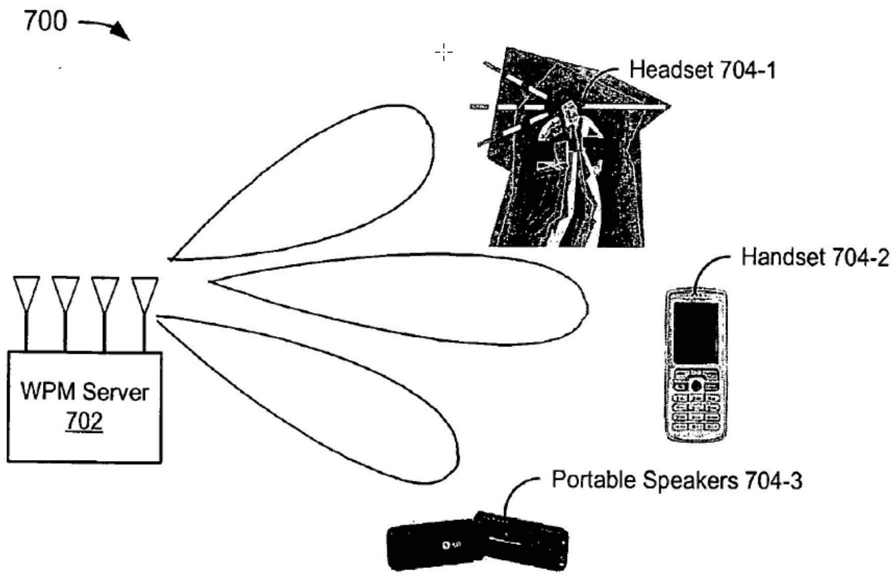

FIG. 7

Figure 7 above shows WPM server 702 in wireless communication with three WPM clients, including headset 704-1, handset 704-2, and portable speakers 704-3. Ex. 1097 ¶ 69.

2. *Rezvani-875*

Rezvani-875 discloses a "wireless multi-media headset with high fidelity sound" that performs a "seamless handoff between multiple wireless interfaces." Ex. 1016, code (57). The headset includes several applications and wireless systems, including various cellular, Wi-Fi, and Bluetooth standards. *Id.*

Rezvani-875's Figure 2 follows:

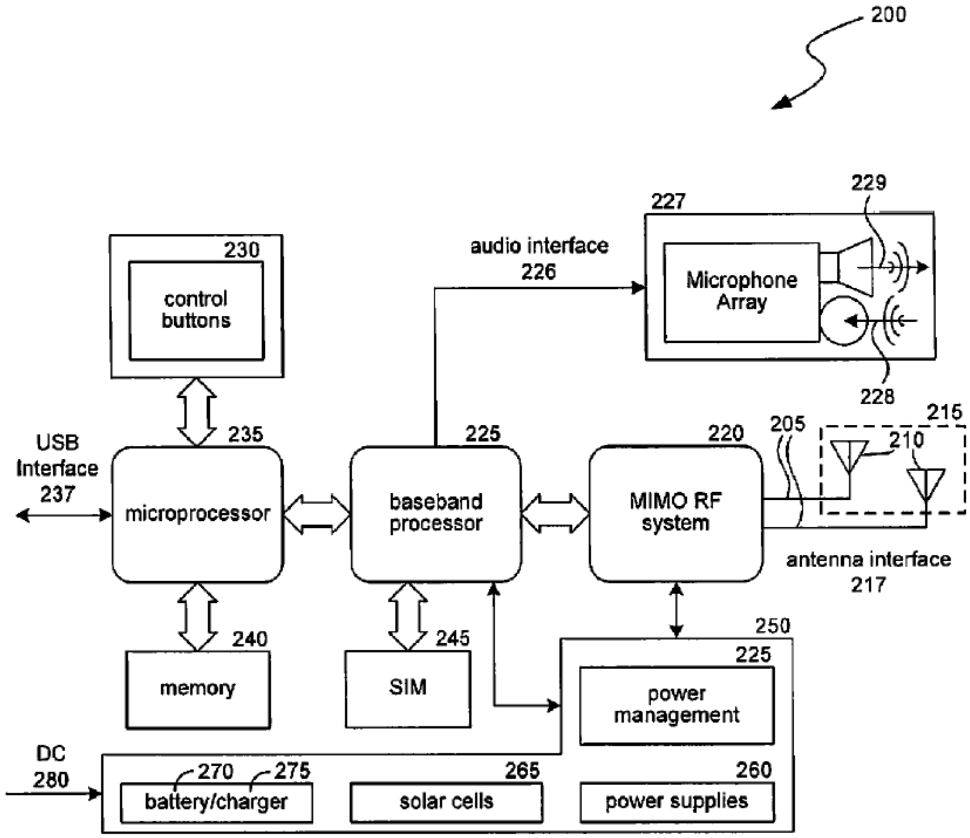

FIG. 2

Figure 2 "illustrates the subsystems that support the various headset functionalities according to some embodiments." Ex. 1016 ¶ 20. These subsystems include antenna array 215, baseband processor 225, microphone array 227, and control buttons 230 for headset user interface 105. *Id.* ¶¶ 17, 20, Fig. 1. Microprocessor 235 performs operations for the various functionalities with the assistance of internal memory 240. *Id.* Power subsystem 250 includes power supplies 260, solar cells 265, battery 270, and battery charger 275. *Id.* ¶ 21.

3. Skulley

Skulley discloses that headsets include one or two earphones classified into three general types: (1) "[i]n-the-ear" earphones, also referred

to as “ear buds”; (2) “[o]n-the-ear” earphones; and (3) “[o]ver-the-ear” earphones. Ex. 1017, 1:21–34.

4. Hind

Hind generally discloses “[m]ethods, systems and computer program products which provide secure updates of firmware (i.e., data stored in a programmable memory device of a processing system).” Ex. 1019, code (57). Hind explains that “[m]any devices today” include “software instructions embedded in the device.” Ex. 1019, 1:23–25. This “software” is “often called firmware because of its persistent association with the device hardware operations.” *Id.* at 1:26–28. “[I]t was historically placed in read-only memory (ROM) and was activated when the device was powered on.” *Id.* at 1:28–30. Hind explains that over time, “it was recognized that firmware, like other forms of software, might be subject to coding mistakes and the over the lifetime of the device there was a need to modify the functional characteristics of the device, for example, to adapt it to a new target environment.” *Id.* at 1:29–33.

Hind states that “[t]he extensive increase in network connectivity in recent years has resulted in an increase in the number of firmware-driven devices that allow personality updates,” even though these updates may present “security problems.” *See* Ex. 1019, 1:44–48.

Hind’s “invention” distributes “firmware updates,” which may include “corresponding certificates associated with a firmware update.” Ex. 1019, 18:46–51. “[S]ervers or other such devices known to those of skill in the art” may provide the firmware updates over the “Internet or an intranet” to “updateable devices” that “may be any type of computing device capable of carrying out some or all of the operations described” in Hind. *Id.* at 18:51–64, Fig. 10. Hind teaches that its “invention” applies to “wireless

stereo headphones" with a "microprocessor" to receive such "secure[] upgrade[s]" "by means of a microcode download transmitted wirelessly from, for example, the Internet." *Id.* at 19:40–47.

5. *Independent Claims 1 and 9*

Relying on citations to the asserted prior art and testimony of Dr. Williams, Petitioner contends that the proposed combination of Rezvani-446, Rezvani-875, Skulley, and Hind would have rendered claims 1 and 9 obvious. Pet. 51–73, 76. Patent Owner disagrees. PO Resp. 21–26, 52–61 (alleging commercial success); Sur-reply 6–8, 23–24.

a) *Claim 1 and 9 Limitations*

Regarding most of the limitations of claim 1, Petitioner contends that Rezvani-875 discloses a headphone assembly comprising the claimed first and second earphones, antenna, wireless communication circuit, processor, memory, rechargeable battery, and microphone (i.e., the headset depicted in Figure 2). Pet. 59–70 (citing Ex. 1016, Fig. 2). Petitioner also contends that Rezvani-446 discloses a headphone assembly (i.e., headset 704-1). *See id.* at 63 (reproducing Ex. 1097, Fig. 7). To the extent Rezvani-875 does not disclose "two-earphone headphones," Petitioner contends that two ear phones would have been obvious in view of Skulley's teachings, as "one of two predictable configurations—one or two earphones," and also, would have provided "unique benefits." Pet. 56–57 (citing Ex, 1005 ¶¶ 47–48, 141, 148–149; Ex. 1017, 1:22–38; Ex. 1020 ¶ 10).

Antenna limitation 1C follows: "an antenna for receiving wireless signals from a mobile, [DAP] via one or more ad hoc wireless communication links." Petitioner contends that Rezvani-875's antenna 210 or antenna array 215 receives wireless signals. Pet. 62 (citing Ex. 1016 ¶¶ 20, 40–41, Fig. 2; Ex. 1003 ¶¶ 321–325).

Regarding the recited mobile DAPs, Petitioner contends that Rezvani-446 discloses using mobile wireless handset 704-2 with WPM server 702 for wireless communication, and also communicating between a headset and headset. Pet. 62–64 (citing Ex. 1097 ¶¶ 4, 22, 69, Fig. 7; Ex. 1003 ¶¶ 322–328). Petitioner also contends that Rezvani-875 "teach[es] that wireless headsets were commonly used 'in conjunction with cell phones' for 'hands-free operation.'" *Id.* at 63 (quoting Ex. 1016 ¶ 4; citing *id.* at Fig. 9 (showing communications between headset and handset)). Petitioner cites evidence tending to show that "[b]y 2008, cell phones commonly stored and transmitted music." *Id.* (citing Ex. 1003 ¶ 111; Ex. 1128 ¶ 19 (describing handset compatible with Rezvani-446's server system that includes an "MP3 engine"), ¶ 20 (describing "music streaming");[20] Ex. 1130 ¶¶ 2–4, 13).

Based on these contentions, Petitioner argues that it would have been obvious to one of ordinary skill in the art at the time of invention to implement the combination of Rezvani-446, Rezvani-875, Skulley, and Hind with "a handset and/or MP3 player" capable of storing digital audio content "because Rezvani-446 teaches that music from the WPM server is either streamed to WPM clients or downloaded to those clients for later playback." Pet. 64 (citing Ex. 1097 ¶ 73; Ex. 1016 ¶ 33).

Limitation 1I recites that the headphone assembly "is configured to play, by the first and second earphones, digital audio content transmitted by the mobile, digital audio player via the one or more ad hoc wireless communication links." Petitioner contends that the combination of Rezvani-446, Rezvani-875, Skulley, and Hind teaches this feature because Rezvani-

[20] Ex. 1128 is another patent publication listing Rezvani et al. as inventors, and it refers to Rezvani-446 via its title and filing date at cited paragraph 19.

875 teaches transmitting digital "'voice signals receive[d] by the handset,' *i.e.*, a telephone call" and Rezvani-446 teaches downloading music from a WPM server to DAPs (handset 704-2 and/or an MP3 player). *See* Pet. 70–71 (alteration in original) (citing Ex. 1016 ¶ 4; Ex. 1097 ¶¶ 42–43, 58–59; Ex. 1003 ¶ 338; Ex. 1005 ¶¶ 133–134). According to Petitioner, "Rezvani-875 confirms that using a digital MP3 player to communicate with a wireless headset using 'wireless technology' was conventional." *Id.* at 64 (citing Ex. 1016 ¶ 4; Ex. 1132 ¶¶ 7–10).

Petitioner generally asserts that the combination would have provided flexibility including hands-free operation and would have allowed a head-set user to stream and/or store music from the server to the DAP, where Rezvaini-875 teaches use of wireless headsets "in conjunction with cell phones" for "hands-free operation." *See* Pet. 63–64 (citing Ex. 1016 ¶ 4, Fig. 9). Also, Petitioner provides evidence that "communicating with servers was an intended purpose of the headset" of Rezvani-446, further suggesting use of Rezvani-875's headset with Rezvani-446's modified system. *See id.* at 57–58 (citing Ex. 1003 ¶¶ 302, 307).

Limitations 1J and 1K, which include recitations of a "server," follow:

> [1J] wherein the processor is configured to, upon activation of a user-control of the headphone assembly, initiate transmission of a request to a remote, network-connected server that is in wireless communication with the mobile, digital audio player;
>
> [1K] and wherein the headphone assembly is for receiving firmware upgrades transmitted from the remote, network-connected server.

Addressing limitation 1J, Petitioner contends that Rezvani-446's "WPM ('wireless portable media') server [702]" wirelessly connects "with

handset 704-2 and/or an MP3 player (*i.e.*, each mobile DAPs . . .)." Pet. 71–72 (emphasis omitted) (annotating Ex. 1097, Fig. 7; citing Ex. 1097 ¶¶ 45–48, 69; Ex. 1003 ¶¶ 341–342). Petitioner relies on Rezvani-446's search functionality and "control buttons [to] initiate other 'commands . . . such as rewind, fast-forward' that 'may be sent by the user via the headset to the WPM server.'" *Id.* at 72 (second alteration in original) (quoting Ex. 1097 ¶ 59; citing Ex. 1003 ¶¶ 339–341). Petitioner asserts that it would have been obvious for Rezvani-875's processor to process this search functionality and commands, because the processor already processes digital data for transmission and the combination "would have been a conventional headphone implementation." *Id.* at 72–73 (citing Ex. 1003 ¶ 340).

Addressing limitation 1K, Petitioner contends that Hind suggests firmware updates from Rezvani-446's WPM server to Rezvani-875's headphone in the combined system to provide performance enhancements and correct software errors. *See* Pet. 57–58 (citing Ex. 1019, 1:23–55, 7:32–51, 19:40–53; Ex. 1003 ¶¶ 300–307; Ex. 1005 ¶¶ 50–70), 72. Claim 9 is similar to limitation 1K and recites that the "headphone assembly of claim 1 is for receiving firmware upgrades wirelessly." Petitioner refers to its showing for limitation 1K and contends that "Rezvani-Rezvani-Skulley-Hind's headphone wirelessly receives firmware upgrades from Rezvani-446's WPM server." *Id.* at 76 (citing Pet. § VI.B.1.f(11); Ex. 1003 ¶¶ 360–361).

b) Patent Owner's Arguments

Patent Owner argues that "neither Hind, Petitioner nor Petitioner's experts provided any insight or explanation as to how 'a microcode download' relates to the 'firmware upgrades' of claim 1." PO Resp. 22.

Claim 1 recites "[1F] a memory for storing firmware that is executed by the processor" and "[1K] . . . wherein the headphone assembly is for receiving firmware upgrades transmitted from the remote, network-connected server."

Patent Owner does not dispute that Petitioner shows that the combined teachings suggest microcode upgrades from a server to a headphone assembly. *See, e.g.*, Pet. 57–58; Ex. 1003 ¶¶ 313, 344. The Petition explains that a person of ordinary skill "would have would have wanted to receive firmware updates for the same reasons discussed . . . for Schrager-Goldstein's similar headset (e.g., 'performance enhancements' and repairing 'coding errors' with minimal user involvement)." Pet. 57 (citing Ex. 1003 ¶ 310). As indicated above, Hind specifically teaches "[m]ethods, systems and computer program products which provide *secure updates of firmware* (i.e., data stored in a programmable memory device of a processing system)." Ex. 1019, code (57) (emphasis added).

Petitioner also persuasively shows that "'[m]icrocode' is another name for 'firmware.'" Reply 5 (citing Ex. 1148, 1:13–15 ("microcode[] alternatively called firmware"); Ex. 1149, 10:14–15 ("microcode (i.e., firmware)"); Ex. 1160 ¶ 13 (testifying that "'microcode' is a form of 'firmware'") (citing Ex. 1148; Ex. 1149)), ¶ 14 (explaining how "Hind discloses that microcode serves the same purpose [as firmware]: it "control[s] a digital signal processor" and is upgraded "to add entirely new functions" (quoting Ex. 1019, 19:37–53)).

Relying on record evidence, Petitioner persuasively explains that "[t]his is consistent with Hind's explanation that firmware 'control[s]' a device's 'computational elements . . . to give the device its functional personality'" ([Ex. 1019,] 1:23–29) and that microcode likewise "control[s] a digital signal processor" and adds "new functions" to it ([*id.* at] 19:37–

47).” Reply 5. Given Hind’s disclosure of providing firmware upgrades in general, an artisan of ordinary skill would not have considered Hind as treating microcode as something functionally or patentably distinct from firmware in relation to such upgrades. *See* Ex. 1019, code (57); *supra* § II.G.4 (describing Hind’s teachings and noting that Hind’s “invention” distributes “firmware updates,” which may include “corresponding certificates associated with a firmware update” (Ex. 1019, 18:46–51)).

Moreover, as Petitioner points out, “setting aside ‘microcode’ in Hind Column 19, Ground 2A also relied on Hind’s numerous disclosures of downloading ‘firmware’ to devices from a server, and the benefits of doing so.” Reply 6 (citing Pet. 55, 57–58; Ex. 1003 ¶¶ 294–299, 308–313; PO Resp. 9 (conceding that Hind discloses “firmware updates” for devices)). As one example, Dr. Williams relies on Hind’s statement that “firmware, like other forms of software, might be subject to coding mistakes and that over the lifetime of the device there was a need to modify the functional characteristics of the device, for example, to adapt it to a new target environment.” Ex. 1003 ¶ 310 (quoting Ex. 1019, 1:23–54). In addition, “[a]s Hind taught, firmware allowed for the device manufacturer to add ‘performance enhancements or . . . to accommodate new parameters not available at the time of distribution of the product’ and repair ‘coding errors.’” *Id.* (quoting Ex. 1019, 1:34–37, 19:54–57).

In its Sur-reply, Patent Owner argues that “[n]either the Petition nor Williams’s original declaration (BOSE-1003) opined on the relationship between microcode and firmware,” so that Petitioner’s Reply argument and evidence is “improper.” Sur-reply 6. Contrary to this argument, the Petition provides ample notice that Petitioner relies on microcode as firmware (and also, Hind’s firmware teachings in general as noted above). For example,

the following statement in the Petition directly ties microcode and firmware together:

> Incorporating Hind's remote-*firmware-update* functionality would have also been routine because Hind teaches it was compatible with "wireless stereo headphones containing a microprocessor [and] memory" (as in Rezvani-Rezvani-Skulley) by "means of a *microcode* download transmitted wirelessly from" servers accessible over a wireless connection to the Internet, and Rezvani-875's headset already had functionality to exchange software with Rezvani-446's WPM server via its Internet connection (*infra* §VI.B.1.f(10)).

Pet. 58 (emphasis added) (citing Ex. 1019, 19:40–47; Ex. 1016 ¶¶ 19–21, 33–37; Ex. 1097 ¶¶ 26–28; Ex. 1003 ¶ 313).

Based on the foregoing discussion, Patent Owner's arguments do not undermine Petitioner's persuasive showing that Hind teaches the firmware upgrades required by claims 1 and 9.

Patent Owner also argues that "Petitioner failed to prove . . . that Rezvani-875's Figure 2 depicts a headset." PO Resp. 23. Patent Owner adds other arguments in an attempt to support this main argument. For example, Patent Owner adds that "Petitioner and its experts did not explain why Figure 2 of Rezvani-875 depicts a headset given that it includes a SIM card." *Id.* at 24. As another example, Patent Owner argues that Figure 2 includes other components not available "in Wireless headsets circa 2008." *Id.* The record does not support Patent Owner's argument.

As Petitioner argues, Patent Owner "***already told this Board*** that Figure 2 depicts components of Rezvani-875's headset." Reply 6 (citing Ex. 1151 (Patent Owner's Response in IPR2021-00297), 10). In cited IPR2021-00297, Patent Owner states that "Rezvani's headset includes an 'output 229'" and "Rezvani's headset also includes a baseband processor

225 and a microprocessor 235," citing Rezvani-875, Fig. 2 for support. Ex. 1151, 10.[21]

As Petitioner also argues, Rezvani-875 "expressly state[s] that headset components are 'shown' in Figure 2." Reply 9 (citing Ex. 1016 ¶ 38 ("As shown in FIG. 2, the headset . . . ."), ¶ 47 (As shown in FIG. 2, the headset . . . .")). Nevertheless, Patent Owner argues that paragraph 38 is a "single, passing reference to a headset" that "merely explains that the headset could include a 'power management algorithm' like the device depicted in Figure 2," so paragraph 38 "would not override a POSA's interpretation that Figure 2 does not depict a headset because of all the cell phone components and non-headset components depicted in Rezvani-875's Figure 2." *Id.* at 25–26 (citing Ex. 2047 ¶ 46 (testifying to "the single, isolated reference to a headset in ¶ [0038]")).

Rezvani-875 does not support this argument and testimony. Paragraph 38 does not represent a "single" reference to a headset in Figure 2. Paragraph 47 represents another reference to the headset in Figure 2. Also, paragraph 38 (emphasis added) itself includes two references to a headset, stating "[a]s shown in FIG. 2, *the headset* may have an optional power management algorithm that minimizes power consumption based on usage of *the headset*." Contrary to Patent Owner's argument, paragraph 38 does not refer to a power management system "like the device depicted in Figure 2."

Patent Owner's arguments in its Sur-reply do not address this evidence or otherwise undermine Petitioner's showing. *See* Sur-reply 6–8.

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[21] Patent Owner cites "(BOSE-1016, Fig. 2)" at page 10 of its Patent Owner Response in IPR2021-00297, and BOSE-1016 is Resvani-875. *See* IPR2021-00297, Ex. 1016.

Patent Owner also argues that Mr. McAlexander's "explanation outweighs Williams's testimony" where "McAlexander testified that Rezvani-875 does not directly refer to what is depicted in Figure 2 as a 'headset.'" *Id.* at 7 (citing Ex. 2047 ¶¶ 42–45). At one of the cited declaration paragraphs, Mr. McAlexander testifies that "Rezvani-875 is silent as to the presence of a headset in Figure 2." Ex. 2047 ¶ 42. This testimony is self-contradictory because as noted above, Mr. McAlexander also refers to "the single, isolated reference to a headset in ¶ [0038]" in relation to "Figure 2." Ex. 2047 ¶ 46. In addition, as found in the previous paragraph, Rezvani-875's paragraphs 38 and 47 contradict this testimony and Patent Owner's argument.

Petitioner also persuasively explains that Figure 2's headset includes cellphone hardware or subsystem components that support the functional headset components of Figure 1, and Rezavani-875 describes its disclosed headset as supporting cellular phone standards. *See* Reply 8–9 (citing Ex. 1016 ¶¶ 19, 21–22, 33, 39; Ex. 1160 ¶¶ 28–30). Therefore, Figure 2's illustration of cellular hardware (such as a SIM card) simply represents these cellular phone standards applied in a headphone. *See id.*

In addition to explicitly referring to Figure 2 as representing a headphone, Rezvani-875 otherwise supports Petitioner. For example, paragraph 19 of Rezvani-875 describes "several functionalities" for the headset 100 in reference to Figure 1, and paragraph 20 describes "the subsystems that support the various functionalities." Ex. 1016 ¶¶ 19–20. Paragraph 19 also states that headset 100 supports "various cellular phone standards (3G/2G/GSM/Edge and or Wimax) 170." *Id.* ¶ 19.

Based on the foregoing discussion, Patent Owner's arguments do not undermine Petitioner's showing that Rezvani-875's Figure 2 represents a

headset. In addition, Petitioner's showing as to all the limitations of claims 1 and 9 as summarized above is persuasive and we adopt it as our own.

c) Summary

As discussed in Section II.K below, Patent Owner's objective indicia of nonobviousness are unpersuasive and entitled to little weight. After considering all the evidence, including Patent Owner's objective indicia, we conclude that Petitioner shows by a preponderance of evidence that claims 1 and 9 would have been obvious over the combined teachings of Rezvani-446, Rezvani-875, and Skulley.

6. Claims 2, 3, 5, 7, 10, 11, 14–16, 19, 21, 47, and 49–53

Petitioner provides reasonable and detailed explanations, supported by the testimony of Dr. Williams and Dr. Casali, indicating how the combined teachings of Rezvani-446, Rezvani-875, and Skulley would have rendered claims 2, 3, 5, 7, 9–11, 14–16, 19, 21, 47, and 49–53 obvious. Pet. 73–82. Patent Owner does not present arguments directed specifically to these claims. *See generally* PO Resp.

Petitioner's showing is persuasive and we adopt and incorporate it as our own. *See* Pet. 73–82. Other than its general contentions regarding alleged secondary indicia of nonobviousness as discussed further below, Patent Owner offers no particular arguments with respect to these claims.

As discussed in Section II.K below, Patent Owner's objective indicia of nonobviousness are unpersuasive and entitled to little weight. After considering all the evidence, including Patent Owner's objective indicia, we conclude that Petitioner shows by a preponderance of evidence that claims 2, 3, 5, 7, 10, 11, 14–16, 19, 21, 47, and 49–53 would have been unpatentable over the combination of Rezvani-446, Rezvani-875, and Skulley.

H. Ground 2B: Rezvani-446, Rezvani-875, Skulley, Hind, and Harada ("Signal Strength" Claims)[22]

Petitioner challenges claims 4, 6, 8, 12, 13, 17, 18, 20, 22, and 58–62 (the Signal Strength claims)[23] as unpatentable under 35 U.S.C. § 103(a) based on Rezvani-446, Rezvani-875, Skulley, Hind, and Harada. Pet. 82–87. Petitioner's allegations and evidence for the additional limitations of the Signal Strength claims are substantially the same as presented for grounds 1B and 1D, discussed in Section II.F above. In particular, Petitioner argues that Harada teaches a technique for selecting among audio sources based on received signal strength, that a skilled artisan would have applied this teaching to the Rezvani-446/Reszvani-875/Skulley/Hind headset, and that the combination would have been the use of a known technique to improve a similar electronic device in the same way. Pet. 82–86.

For the same reasons as given in Section II.F above, we find that Harada does not supply the limitation of the Signal Strength claims missing from Rezvani-446, Rezvani-875, Skulley, and Hind, and further find that Petitioner has not articulated a reason, with rational underpinning, to combine the teachings of Harada with those of Rezvani-446, Rezvani-875, Skulley, and Hind. Accordingly, Petitioner has not proved, by a preponderance of the evidence, that claims 4, 6, 8, 12, 13, 17, 18, 20, 22, and 58–62 would have been obvious over Rezvani-446, Rezvani-875, Skulley, Hind, and Harada.

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[22] As indicated in the case caption above, *Administrative Patent Judge* McKone is the author of this Signal Strength section, with whom *Administrative Patent Judge* Scanlon joins. *Administrative Patent Judge* Easthom dissents as to this section as indicated above and below.
[23] The Signal Strength claims also include claims 38, 40, and 41, addressed below. *See* PO Resp. 27 ("Ground 2D includes claims 38, 40 and 41.").

I. Ground 2C: Rezvani-446, Rezvani-875, Hind, and Oh

Petitioner challenges claims 32–37, 39, and 54–57 as unpatentable under 35 U.S.C. § 103(a) based on Rezvani-446, Rezvani-875, Hind, and Oh. Pet. 87–95. Patent Owner disagrees. PO Resp. 37–39, 40–44, 48–61; Sur-reply 15–20, 23–24. As discussed above (§§ II.D.5–6), these claims generally add and recite different structural (form factor) features and other component (DSP) features of earphones to limitations as generally recited in claim 1.

1. Oh

Oh teaches "wireless stereo earphone[s]" that fit "into the ears" (*i.e.*, earbuds). Ex. 1099 ¶¶ 1, 19. Figure 1 of Oh follows:

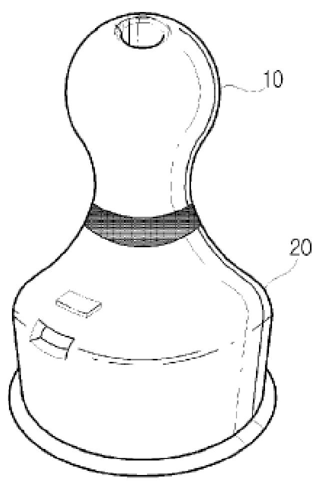
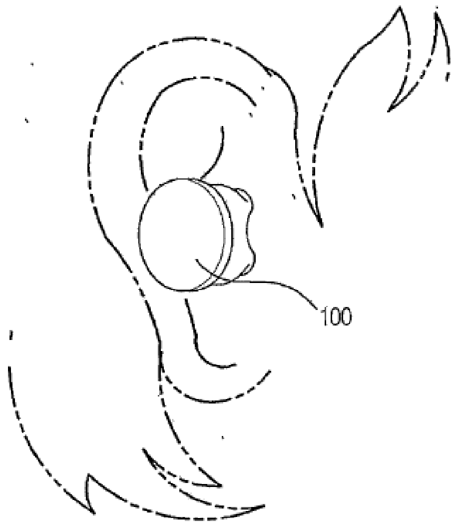


Figure 1 above illustrates wireless earphone 100 shaped as an "earplug," and includes inserting unit 10 for placing in an ear of a user, and main body 20, which includes an antenna, battery, speaker, and "a signal processing circuit for performing a wireless headset function." Ex. 1099 ¶ 30.

Oh's Figure 6 follows:



Oh's Figure 6 shows Oh's earplug 100 with "inserting unit 10 [put] into the [user's] earhole." Ex. 1099 ¶ 31.

Each earphone "ha[s the] same hardware configuration." Ex. 1099 ¶ 41. Oh's Figure 5 follows:

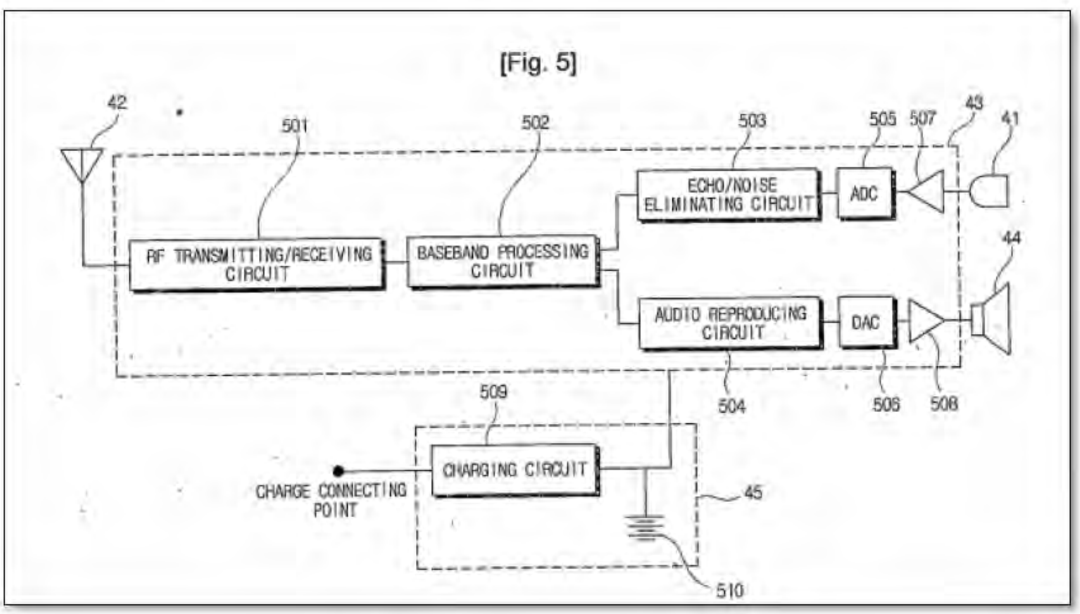


Figure 5 above illustrates the hardware circuit in each earphone, including antenna 42, speaker 44, signal processing circuit 43, battery 45

with rechargeable battery 510 and charging circuit 509, RF transmitting/receiving circuit 501 (*e.g.*, for WLAN/Wi-Fi or Bluetooth), baseband processing circuit 502, and echo eliminating circuit 503, which may include a DSP. Ex. 1099 ¶¶ 34, 37, 41, 44, 50, 52.

Oh teaches charging its earphones by inserting them into mounting unit 201 connected to the "mobile communication terminal," *e.g.*, mobile phone, as illustrated in Figures 1 and 4. Ex. 1099 ¶¶ 17, 33, 38, 50. Oh also describes a DSP with an "echo eliminating circuit." *Id.* ¶ 40. It "determines when the received audio[] signal is mixed with a transmitting audio signal [during a call], and eliminates the mixed signal." *Id.*

2. Claims 32–37, 39, and 54–57

Claim 32 recites "[t]he headphone assembly of claim 1, wherein: the wireless circuit comprise first and second wireless circuits; the wireless circuit is in the first earphone; and the second wireless circuit is in the second earphone. Claim 33 recites "[t]he headphone assembly of claim 32, wherein each of the first and second earphones comprise earbuds."

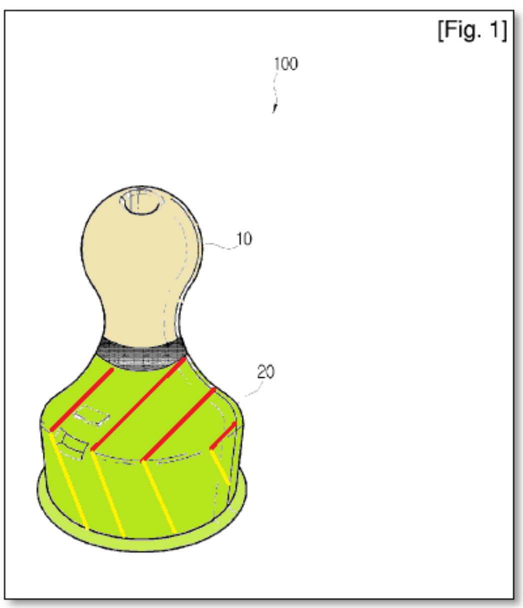
Addressing claims 32–37, 39, and 54–57, Petitioner provides reasons, supported with the testimony of Dr. Williams and Mr. Casali, for why one of ordinary skill in the art would have employed two earbuds in the combined system of Rezvani-875, Rezvani-446, and Hind based on Oh's earbud teachings. Pet. 87–95. Petitioner asserts a reasonable expectation of success as a routine of use of such earbuds, further contending that the combined system would have provided economic (replacement) benefits, stereo sound, protection of the earbuds, secure earbuds, storage for chargeable earbuds, and avoided wire connections. *See id.* (citing Ex. 1097 ¶¶ 4, 17, 26–28, 33, 38, 50, Fig. 5; Ex. 1099 ¶¶ 11, 12, 19, 30–32, 34, 37, 41, 42, 52, 82;

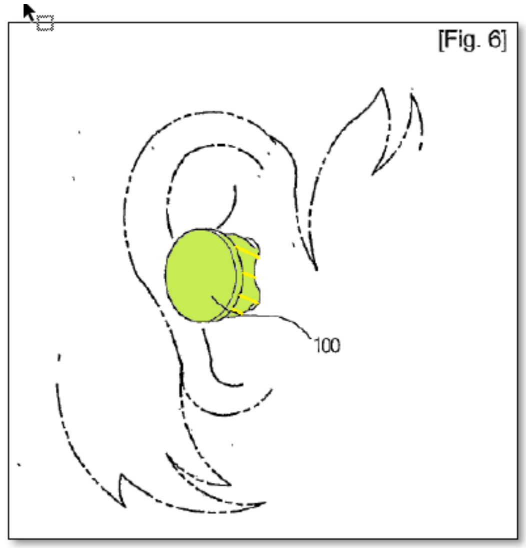
Ex. 1003 ¶¶ 347–355, 437–441, 443–449, 456–463, 474–479; Ex. 1005 ¶¶ 77–80, 143, 161, 164–171).

Claim 34 depends from claim 33 and recites comprise "[t]he headphone assembly of claim 33, wherein each of the first and second earphones comprises: a body portion that sits at least partially in an ear of the user when the headphone assembly is worn by the user; and an elongated portion that extends from the body portion."

To address claim 34, Petitioner builds on its showing with respect to claims 32 and 33, alleging it would have been obvious to include Oh's earbud form factors in the combined system of Rezvani-446, Rezvani-875, and Hind for the reasons outlined above, including to provide economic (replacement) benefits, etc. *See* Pet. 92 (citing Pet. §§ VI.B.3.b, VI.B.3.d).

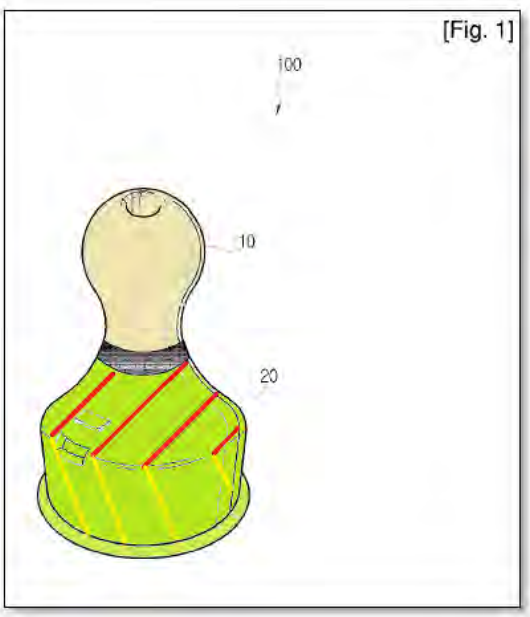
To support its showing, Petitioner produces annotated versions of Oh's Figures 1 and 6, as follows:





In the figures above, Petitioner adds color annotations to Oh's Figure 1 (a picture of an earbud outside of an ear) and Figure 5 (a picture of an earbud inserted into an ear). Petitioner contends that as illustrated above, Oh teaches "'a body portion ["main body 20," lime] that sits at least partially in the ear of the user when the headphone assembly is worn by the user [red-stripes in; yellow-stripes out],' as claimed." Pet. 92 (citing Ex. 1099 ¶¶ 30, 33; Ex. 1005 ¶¶ 165–166) (alterations in original). Petitioner also contends that "[a]s shown above, this design includes 'an elongated portion [inserting unit 10, beige] that extends from the body portion,' as claimed." *Id.* (citing Ex. 1099 ¶¶ 30–32; Ex. 1005 ¶¶ 165–166) (second alteration in original).

Petitioner compares Oh's form factor earbud design in Figure 1 with that of the '934 patent's Figure 1A, as follows:



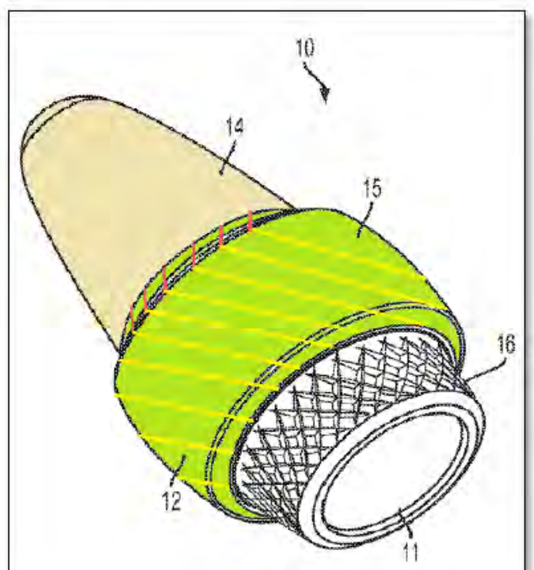


FIG. 1A

In the figures above, Petitioner adds color annotations to Oh's Figure 1 and the '934 patent's Figure 1A, both pictures of earbuds. As illustrated above, Oh's earbud and the '934 patent's earbud each include a beige elongated portion (i.e., 10 or 14) that extends from a lime body (i.e.,

20 or 15) portion that sits at least partially in the ear of the user, as claimed. *See* Pet. 92–93.[24]

Under an alternative showing for claim 34, Petitioner asserts that it would have been obvious "to design each earbud with an earloop (*e.g.*, Ex. 1033's earhook 13), which is also an elongated portion extending from the body, to better secure the earbud when worn by the user." Pet. 93 (citing Ex. 1033, 6:34–35, Figs. 3b–3b, 7:9–10, 7:59–63; Ex. 1003 ¶ 458; Ex. 1005 ¶ 167; Pet. § VI.A.1.m).

Claims 35–37 and 39 depend directly or indirectly from claim 34. To address these claims Petitioner relies partly on its showing above with respect to claim 34 and its showing with respect to claims 2 and 3, and provides reasons supported by the record in alleging obviousness. Pet. 93–94.

Patent Owner does not address Petitioner's alternative obviousness showing with respect to claim 34, which, as noted above, involves an earloop extending from the earbud body in its Response. *See* PO Resp. 37–43. Rather, the Response relies on a claim construction argument, asserting that claim 34 requires three distinct parts, an "elongated portion," a "body portion," and an "earbud." *Id.* at 41. According to Patent Owner, under Petitioner's "theory, no part of Oh is left to correspond to the 'earbud' of claim 34," such that there "is an earbud distinct from the claimed 'body portion' and 'elongated portion.'" *Id.* at 41–42 (citing Pet. 91; Ex. 2047 ¶ 65). Patent Owner also argues that "claims 35–41 would not have been obvious at least by virtue of their dependence upon claim 34." *Id.* at 43.

[24] Patent Owner agrees that "something, such as the [lime] body portion [15, 20], can 'sit[] at least partially in an ear' (quoting claim 34) without being inserted into the ear canal."). *See* Sur-reply 16.

Patent Owner represents its claim construction argument with the following figure:

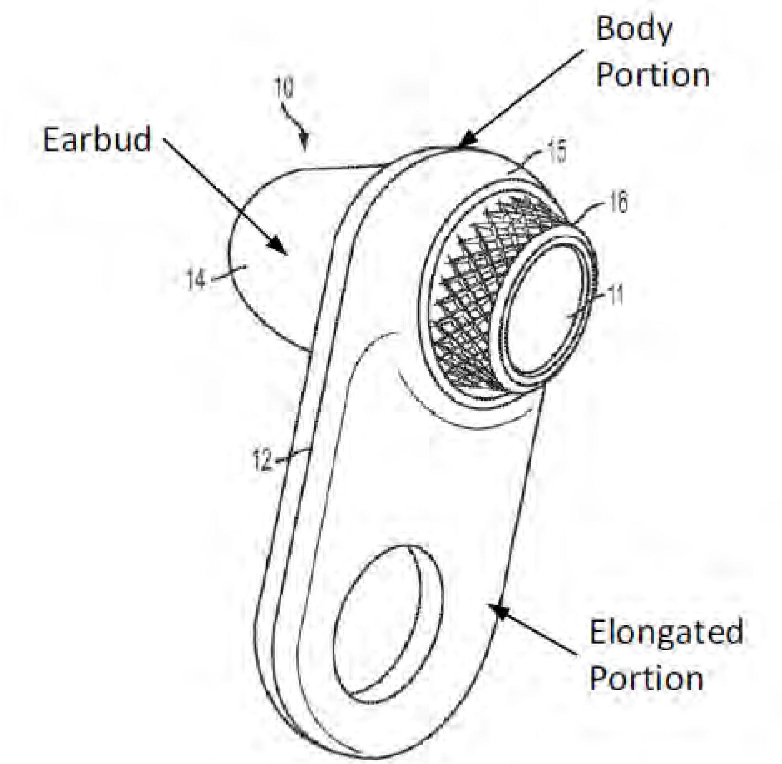


FIG. 1B

Figure 1B above, as annotated by Patent Owner, illustrates a wireless earphone with three distinct portions, an earbud portion, a body portion, and an elongated portion. *See* PO Resp. 37–39. As noted above, Patent Owner argues that "[t]he fact that these elements are distinct is clear because claims 33 and 34 state that each earphone 'comprises' these components." *Id.* at 37.

Contrary to this argument, however, Patent Owner does not point to anything in the '934 patent specification that indicates the inventors intended the term "earbud" to represent *only a portion* of an earphone. Patent Owner does not rely on a plain meaning of earbud or point to evidence as to plain meaning. *See* PO Resp. 37–42; Ex. 1017, 1:21–34 ("classif[ying]

[earphones] into three general types": "1) '*[i]n-the-ear' type earphones*, sometimes referred to as '*ear buds*,' which fit into the concha . . . ; (2) '[o]n-the-ear' types that couple against a lateral face of the auricle or external ear . . . ; and, (3) '[o]ver-the-ear' types that surround . . . the auricle of the user" (emphasis added)); Ex. 1020 ¶ 7 ("An earbud is a small headphone that fits into the concha of the pinna of the user's ear."), Fig. 3 (showing prior art "wired earbuds 302, 304"), ¶ 30, Fig. 5 (showing wireless earbuds 502, 504).

Written together in short-hand form to include limitations of claims 32 and 33, claim 33 essentially recites the following limitations:

> The headphone assembly of claim 1, wherein: the wireless circuit comprises first and second wireless circuits in the first earphone and second earphone, respectively, and each earphone comprises an earbud and comprises a body portion that sits at least partially in an ear of the user when the headphone assembly is worn by the user and an elongated portion that extends from the body portion.

Claim 34 indicates that each earphone comprises an earbud and comprises a body portion and an elongated portion. But this language does not preclude an earbud as a type of earphone comprising the recited body portion and elongated portion. In other words, the earphone comprises an earbud, like a car comprises a convertible. This is the reading that most naturally conforms with the plain meaning of the term as described in the '934 patent specification, as Petitioner essentially argues. *See* Reply 15–19. That is, as Petitioner argues, the '934 patent specification does not refer to "[e]ar canal portion 14" as an earbud. *See id.* (citing Ex. 1001, 3:18–20 ("Ear canal portion 14 . . . is inserted in the ear canal of the user")). Petitioner's annotated version of Figure 1B from the '934 patent follows (Reply 17):

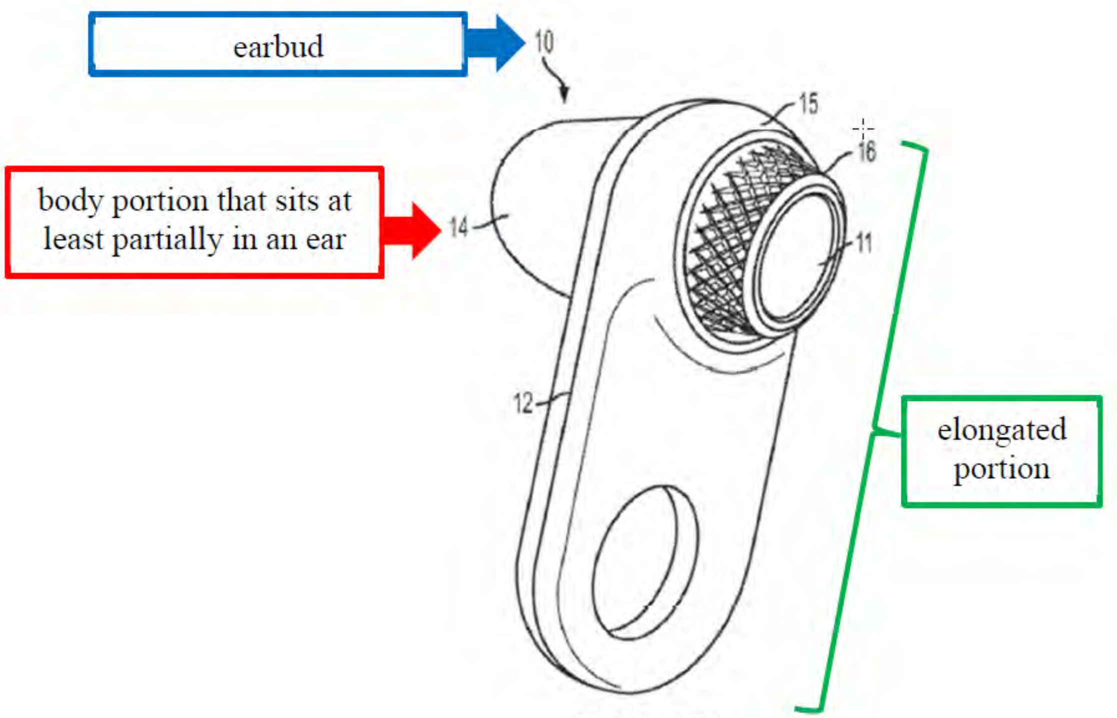


FIG. 1B

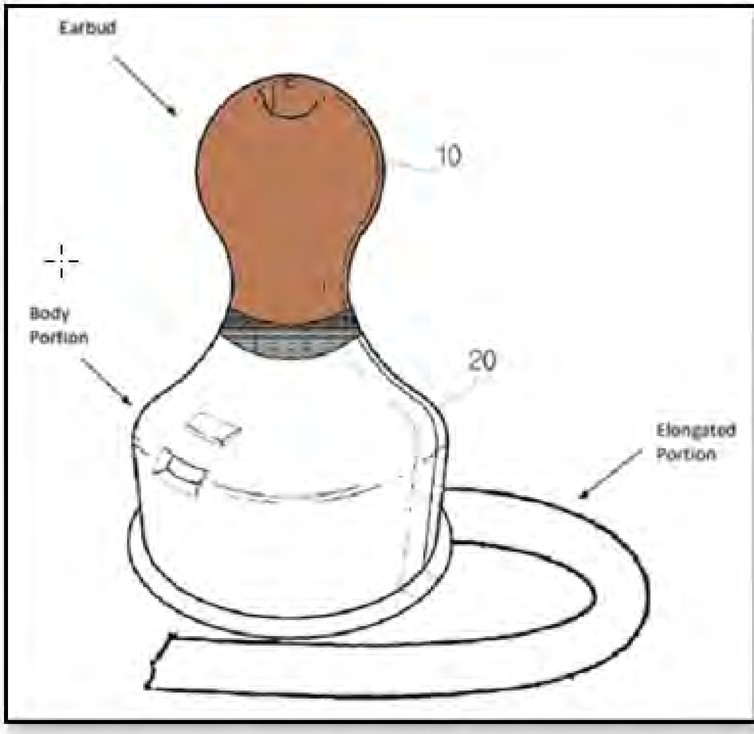
As annotated above by Petitioner, Figure 1B of the ’934 patent shows how claim 34 comprises an earbud that comprises the claimed body portion and elongated portion. As Petitioner argues, this comports with the ’934 patent specification. Reply 17. Specifically, the ’934 patent describes an “earbud earphone” (Ex. 1001, 3:30) and refers the reader to a PCT application (Ex. 1156) that the ’934 patent incorporates by reference, which in turn similarly describes an “earbud style earphone” (Ex. 1156, 60:10). Reply 17 (citing Ex. 1001, 3:29–33; Ex. 1156, 60:9–14). After describing “earphone 10” as including “body 12” that “may comprise ear canal portion 14 that is inserted in the ear canal,” and “also may comprise exterior portion 15 that is not inserted into user’s ear canal,” the ’934 patent specifically refers to “*such an . . . earbud earphone*” and notes it is also disclosed in the PCT application with “[f]urther details.” Ex. 1001, 3:19–32. In other words, the ’934 patent specification clearly indicates that an earbud is a type

of earphone. Nothing in the specification relied upon by Patent Owner supports Patent Owner's claim construction argument.

In addition, Patent Owner contradicts its argument that an earbud is merely a part of an earphone by noting that "earphones" without wires "are sometimes called 'True Wireless' or 'TWS' earphones," and "TWS *earphones are often implemented as earbuds* (e.g., TWS earbuds)." PO Resp. 6 (emphasis added).

Patent Owner's Sur-reply arguments regarding claim construction mischaracterize the '934 patent and the incorporated PCT application by equating an ear canal portion with an earbud merely because they both fit into an ear canal. *See* Sur-reply 15–16. Finally, Patent Owner does not address Petitioner's showing that Oh's earbud and the '934 patent's earbud are remarkably similar, as depicted and discussed above, thereby not undermining Petitioner's clear showing that it reads Oh and claim 34 consistently with a plain meaning of an earbud in light of the '934 specification.

In addition, in Reply to the Response's claim construction argument, Petitioner asserts that "even if 'earbud' were discrete inside the user's ear, Rezvani-Rezvani-Skulley-Hind-Oh unquestionably has one, as the below exemplary illustration of the Petition's second proposed implementation of Rezvani-Rezvani-Skulley-Hind-Oh shows (Reply 21):



Petitioner's figure above identifies three distinct portions of an earbud according to Patent Owner's claim construction theory: an elongated portion, a body portion, and an earbud portion. *See* Reply 21.

In Sur-reply, Patent Owner argues that the Reply's relies "on a new diagram, . . . , in a last-ditch attempt to save its theory," Sur-reply 17. Contrary to this argument, Petitioner's earloop theory is not new. A new diagram is not a new theory, where here, it merely depicts the same theory set forth in the Petition. *Compare* Reply 21, *with* Pet. 93. In addition, the Reply diagram merely responds to Patent Owner's claim construction argument.[25] Accordingly, Patent Owner's arguments asserting that "Oh's

[25] Patent Owner presents its claim construction argument for the first time in the Response and does not assert that it previously advanced this claim construction in a district court proceeding. Of course, Patent Owner is under no obligation to file a Preliminary Response or advance a claim construction

earpiece already has a way to be secured to the user's ear" and "[t]here is no purpose for the 'elongated [earloop] portion'," and similar arguments, asserted for the first time in the Sur-reply, are untimely. *See* Sur-reply 18. These arguments could have been presented in the Response, after Petitioner advanced the same earloop theory in the Petition.

Claims 54–57 depend directly or indirectly from claim 1. Petitioner relies partly on its showing above with respect to claim 33 and its showing with respect to claims 52 and 53, and provides reasons supported by the record in alleging obviousness. *See* Pet. 94–95.

As discussed above (*supra* § II.D.6), dependent claim 56 essentially includes TWS earbuds wherein each earbud includes some of the circuitry recited by claim 1 (antenna, wireless communication circuit, processor, memory, and rechargeable battery), including a DSP for providing "sound quality enhancement for the audio content played by the acoustic transducer of the earphone."

Patent Owner argues that claim 56 states that the DSP provides a sound quality enhancement for the "audio content ***played by the acoustic transducer of the earphone***." PO Resp. 48. In contrast, Patent Owner asserts that "the DSP in Rezvani-875 is for ***speech recognition***," which does not involve playback to the acoustic transducer, but rather, allows searchable file name recognition based on voice commands from the user. *See id.*

Petitioner persuasively replies that this speech recognition argument, even if correct, does not address Petitioner's separate argument that "[u]sing DSPs to enhance playback 'sound quality' (*e.g.*, noise cancellation and

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position prior to, or in, its Response. *See* Prelim. Resp. 10 (citing Ex. 2018); Ex. 2018 (district court claim construction order showing no construction for claim 34); PO Resp. 37–43.

equalization when listening to voice/music) would ***also* have been** a routine implementation POSAs had reason to include at least because by the mid-2000s there were well-known benefits to using DSPs for playback sound-quality enhancements." Reply 24–25 (citing Pet. 80–81). The Petition provides persuasive evidence to support Petitioner's rationale that "by the mid-2000s there were well-known benefits to using DSPs for playback sound-quality enhancements." Pet. 81 (citing Ex. 1003 ¶ 392; Ex. 1136 ¶ 7; Ex. 1137 ¶¶ 4–5; Ex. 1144 ¶ 6; Ex. 1005 ¶¶ 58, 95; Ex. 1035, 1:34–38; Ex. 1136 ¶¶ 5–7; Ex. 1140, 1:7–2:24)).

As one example, Dr. Williams cites Oh as teaching that "digital signal processor can 'determine[] whether the received audio[] signal is mixed with a transmitting audio signal, and eliminates the mixed signal,' thereby '[providing] a sound quality enhancement for the audio content played by the acoustic transducers' as claimed." Ex. 1003 ¶ 392 (quoting Ex. 1099 ¶ 44) (alterations in original). Dr. Williams testifies that Oh "does not discuss the details of this quality enhancement provided by the digital signal processor as they are "well-known to those skilled in the art." *Id.* (quoting Ex. 1099 ¶ 44). Oh supports this testimony. At the cited paragraph, Oh states that "wireless earphones" can have "echo" problems, so "[i]n order to overcome such a shortcoming, an echo eliminating circuit using a digital signal processor (DSP) may be included. . . . *Various echo eliminating technologies* . . . *are well-known to those skilled in the art*. Therefore, details are omitted." Ex. 1099 ¶ 44 (emphasis added). Dr. Williams also relies on Exhibit 1136, which states that "using an adaptive digital feedback filter" a DSP can "generate[] a digital tonal noise cancellation signal" that can be "provided to the speakers in the earcups to cancel noise" and "reduce overall noise within the earcup." Ex. 1003 ¶ 392

(quoting Ex. 1136 ¶ 7) (alteration in original). Dr. Williams relies on another reference, which teaches using a DSP to provide surround sound, thereby enhancing noise quality. *Id.* (citing Ex. 1137 ¶ 5). Dr. Williams also relies on Goldstein, as teaching "apply[ing] DSP techniques to enhance the earphone's sound by compensation for any non-linear frequency responses of an earphone system." *Id.* (citing Ex. 1026 ¶ 90). Describing one implementation of this noise cancellation system, Goldstein describes "active noise cancellation, echo cancellation and signal conditioning . . . customized" to provide "occupation-related noise cancellation," including "noise cancellation parameters tuned to the drilling equipment used by a dentist." Ex. 1026 ¶ 92; *see also* Pet. 39 (describing Goldstein's noise cancellation/equalization techniques (citing Ex. 1026 ¶¶ 90–91).

In Sur-reply, Patent Owner argues that Petitioner's theory fails, because "there is no evidence that it would have been routine for TWS earbuds." Sur-reply 20. As an example, Petitioner states that "Oh's DSP eliminates echo in audio signals ***transmitted*** by the earphone." *Id.* at 21 (citing Ex. 1099 ¶¶ 42–44). Patent Owner also argues that "Goldstein does not disclose a DSP in a TWS earbud that enhances the sound quality output." *Id.* at 21.

Even if Patent Owner is correct that a particular embodiment in Oh or Goldstein, or any other prior art reference relied upon by Petitioner, fails to singularly disclose an earbud with a DSP that enhances sound quality as claimed, this argument does not address Petitioner's reliance on the knowledge of skilled artisans s supported by combined teachings of the references and other record evidence showing that DSP sound quality enhancement techniques for audio content played by the acoustic transducers generally were known. Pet. 80 (citing Ex. 1003 ¶¶ 391–392; Ex. 1005

¶ 145). Goldstein, for example, does not limit its techniques to eliminating noise and/or equalizing nonlinear frequency responses from applying during audio playback. *See* Ex. 1026 ¶¶ 90–92; Ex. 1003 ¶ 392. In any event, Patent Owner does not dispute that DSP sound-enhancing techniques employed in earcup-type headphones generally were well-known. *See* PO Resp. 48 (characterizing Dr. Goldstein's "observation" as supporting Patent Owner's argument that "DSP[s] for active noise cancellation were only 'often implemented' in over-the-ear headphones that had earcups, not in TWS earbuds"); Sur-reply 20 (arguing that Dr. "Casali merely testified that by 2008, active noise cancellation was implemented in over-the-ear headphones with earcups"), 21 (arguing that Dr. Casali "only mentioned DSPs being used in headsets with earcups").

Therefore, Patent Owner's arguments do not undermine Petitioner's showing that it would have been obvious to implement DSP audio enhancement well-known techniques, to provide known benefits of better sound, as suggested by Oh's DSP noise cancelling earbud design, Goldstein's DSP noise cancellation earbud design, Rezvani-875's DSP, noise cancellation design, and the noted DSP earcup noise cancellation teachings, resulting in, *inter alia*, increasing the signal to noise ratio of a received audio signal for any sound source and receiver. *See* Pet. 80–81; Reply 24–25.

In addition to the testimony of Dr. Williams, Dr. Casali testifies as follows:

> By 2008, electronic active noise cancellation techniques to reduce ambient noise under the headset's earcups and thus enhance sound quality for the listener were often implemented using a digital signal processor (DSP) in the headset. *See, e.g.*,

> Eichler (Ex. 1136), [0005]–[0007] (describing as background information "activate noise cancellation" techniques for "aircraft headset system[s]," where "[a] digital signal processor (DSP) takes the digital error signal and using an adaptive digital feedback filter generates a digital tonal noise cancellation signal." "A digital to analog converter then converts the digital tonal noise cancellation signal to an analog tonal noise cancellation signal to form a composite cancellation signal" that is "provided to the speakers in the earcups [of earphones] to cancel noise within the earcups.")

Ex. 1005 ¶ 58.

Dr. Casali also testifies that "a POSA would have known to apply DSP techniques to enhance the earphone's sound by compensation (e.g., equalization) of any non-linear frequency response of an earphone system, per Goldstein." Ex. 1005 ¶ 58 (citing Ex. 1026 ¶ 90). In addition to relying on Oh, Eichler, Casali, and Goldstein, both declarants persuasively cite other record evidence to support their testimony, as the Petition indicates. *See* Pet. 81; Ex. 1003 ¶ 392; Ex. 1005 ¶ 58.

Patent Owner also argues that claim 56 would not have been obvious because of the high heat generated by DSPs, creating "a challenge for a POSA to include a DSP in an earbud along with the other requirements of a wireless earbud." However, as indicated above, Oh discloses a wireless earbud with a DSP, a rechargeable battery, and other wireless earbud circuit components. *See supra* II.I.1; II.D.6 (addressing similar arguments); Ex. 1099 ¶ 44 (describing earbud DSP echo eliminating circuit). Patent Owner's remaining Sur-reply arguments track its unavailing arguments addressed here and also above in connection with Ground IA. *See supra* § II.D.6; Sur-reply 21 (arguing that "Casali did not testify that it was known or conventional to include DSPs in TWS Earbuds"), 20 (arguing that "neither Casali nor Williams explained why it would have been obvious for

a POSA to implement a DSP in each TWS earbud given the small form factor of an earbud”).

Patent Owner also argues that “Petitioner never explained why it would be routine to include such a relatively large SIM card [as illustrated in Rezvani-875’s Figure 2] in a small form factor TWS earbud.” Sur-reply 21–22. Petitioner need not explain how to implement the SIM card, because the earbud claims do not require a SIM card, and Petitioner does not propose employing every component of Rezvani-875’s Figure 2 in an earbud.

Considering the record including the discussion below of alleged secondary indicia of nonobviousness, Petitioner’s detailed explanations, articulated rationale with factual underpinnings, and showing of a reasonable expectation of success, supported by the record, show that the combined teachings of Rezvani-446, Rezvani-875, Hind, and Oh would have rendered claims 32–37, 39, and 54–57 obvious. Pet. 73–82, 87–95. Petitioner’s showing is persuasive and we adopt and incorporate it as our own. *See id.* Patent Owner does not provide separate arguments for claims 32, 33, 35–37, 54, 55, and 57. PO Resp. 40–44, 48–52.

As discussed in Section II.K below, Patent Owner’s objective indicia of nonobviousness are unpersuasive and entitled to little weight. After considering all the evidence, including Patent Owner’s objective indicia, we conclude that Petitioner shows by a preponderance of evidence that claims 32–37, 39, and 54–57 are unpatentable over the combination of Rezvani-446, Rezvani-875, Hind, and Oh.

J. Ground 2D: Rezvani-446, Rezvani-875, Hind, Oh, and Harada[26]

Petitioner challenges claims 38, 40, and 41 (the Signal Strength claims) as unpatentable under 35 U.S.C. § 103(a) based on Rezvani-446, Rezvani-875, Hind, Oh and Harada. Petitioner relies on its showing with respect to claims 3 and 4, which recite materially the same claim limitations. *See* Pet. 95–96. For the reasons given in Sections II.F and II.H above, Petitioner has not shown that Rezvani-446, Rezvani-875, Skulley, Hind, and Harada teach all limitations of claims 3 and 4, or that a skilled artisan would have combined the teachings of Harada with those of Rezvani-446, Rezvani-875, Skulley, and Hind. Specifically, we find Petitioner's allegations and evidence as to Harada deficient. Those deficiencies apply equally to Petitioner's allegations as to claims 38, 40, and 41. Petitioner does not contend that Oh supplies the limitation missing from the combination of Rezvani-446, Rezvani-875, Hind, and Harada. Accordingly, Petitioner does not show by a preponderance of evidence that claims 38, 40, and 41 are unpatentable over the combination of Rezvani-446, Rezvani-875, Hind, and Oh.

K. Objective Indicia of Nonobviousness

Patent Owner contends that "[t]he AirPods Products from Apple are TWS earbuds that have achieved significant sales since they were introduced in late 2016, more than seven years after the latest possible priority date for the '934 Patent." PO Resp. 52. Patent Owner also argues there is "a strong

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[26] As indicated in the heading above, *Administrative Patent Judge* McKone is the author of this Signal Strength section, with whom *Administrative Patent Judge* Scanlon joins. *Administrativive Patent Judge* Easthom dissents as to this section as indicated above and below.

nexus between the Challenged Claims and the commercially successful AirPods Products." *Id.*

Objective evidence of non-obviousness "may often be the most probative and cogent evidence in the record" and "may often establish that an invention appearing to have been obvious in light of the prior art was not." *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1349 (Fed. Cir. 2012) (quoting *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983)). Objective evidence may include long-felt but unsolved need, failure of others, unexpected results, commercial success, copying, licensing, and praise. *See Graham*, 383 U.S. at 17–18; *Leapfrog Enters., Inc. v. Fisher–Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007).

"Evidence of commercial success, or other secondary considerations, is only significant if there is a nexus between the claimed invention and the commercial success." *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1311–12 (Fed. Cir. 2006). "When a patentee can demonstrate commercial success, usually shown by significant sales in a relevant market, and that the successful product is the invention disclosed and claimed in the patent, it is presumed that the commercial success is due to the patented invention." *J.T. Eaton & Co. v. Atlantic Paste & Glue Co.*, 106 F.3d 1563, 1571 (Fed. Cir. 1997).

"However, market share data, though potentially useful, is not required to show commercial success." *Chemours Co. FC, LLC v. Daikin Indus., Ltd.*, 4 F.4th 1370, 1378 (Fed. Cir. 2021) (citing *Tec Air, Inc. v. Denso Mfg. Mich. Inc.*, 192 F.3d 1353, 1360–61 (Fed. Cir. 1999) ("Although sales figures coupled with market data provide stronger evidence of commercial success, sales figures alone are also evidence of commercial

success.”); *Gambro Lundia AB v. Baxter Healthcare Corp.*, 110 F.3d 1573, 1579 (Fed. Cir. 1997) (relying on sales information to show commercial success); *J.T. Eaton*, 106 F.3d at 1566, 1572 (same)) (reasoning that “[t]he Board is certainly entitled to weigh evidence and find, if appropriate, that Chemours’s gross sales data were insufficient to show commercial success without market share data,” and holding that “[t]he Board, however, erred in its analysis that gross sales figures, absent market share data, ‘are inadequate to establish commercial success’”).

“For objective evidence of secondary considerations to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention.” *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010)). “A nexus may not exist where, for example, the merits of the claimed invention were ‘readily available in the prior art.’” *ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016) (quoting *Richdel, Inc. v. Sunspool Corp.*, 714 F.2d 1573, 1580 (Fed. Cir. 1983)). “Additionally, there is no nexus unless the evidence presented is ‘reasonably commensurate with the scope of the claims.’” *Id.* (quoting *Rambus Inc. v. Rea*, 731 F.3d 1248, 1257 (Fed. Cir. 2013)). “There is no hard-and-fast rule for this calculus, as ‘[q]uestions of nexus are highly fact-dependent and, as such are not resolvable by appellate-created categorical rules and hierarchies as to the relative weight or significance of proffered evidence.’” *Id.* at 1221–1222 (quoting *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1331 (Fed. Cir. 2016) and reasoning that “because claims 2 and 14 are considerably broader than the particular features praised in the articles, it would be reasonable for the Board to assign this evidence little weight”).

A patentee obtains a presumption of nexus “when the patentee shows that the asserted objective evidence is tied to a specific product and that

product 'embodies the claimed features, and is coextensive with them.'" *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (quoting *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1072 (Fed. Cir. 2018)). "[T]he patentee retains the burden of proving the degree to which evidence of secondary considerations tied to a product is attributable to a particular claimed invention." *Fox Factory*, 944 F.3d at 1378. "[I]f the marketed product embodies the claimed features, and is coextensive with them, then a nexus is presumed and the burden shifts to the party asserting obviousness to present evidence to rebut the presumed nexus." *Brown & Williamson Tobacco Corp. v. Philip Morris Inc.*, 229 F.3d 1120, 1130 (Fed. Cir. 2000). Coextensive "mean[s] that the product is the invention disclosed and claimed. . . . A product is essentially the claimed invention when, for example, the unclaimed features amount to nothing more than additional insignificant features." *Campbell Soup Co. v. Gamon Plus, Inc.*, 10 F.4th 1268, 1276–77 (Fed. Cir. 2021) (emphasis and internal quotations omitted, citation omitted). A patent owner "bears the burden of showing that a nexus exists." *WMS Gaming Inc. v. Int'l Game Tech.*, 184 F.3d 1339, 1359 (Fed. Cir. 1999).

"A finding that a presumption of nexus is inappropriate does not end the inquiry into secondary considerations"; rather, "the patent owner is still afforded an opportunity to prove nexus by showing that the evidence of secondary considerations is the 'direct result of the unique characteristics of the claimed invention.'" *Fox Factory*, 994 F.3d at 1374–75 (quoting *In re Huang*, 100 F.3d 125, 140 (Fed. Cir. 1996)). In other words, "[w]ithout the presumption, a patentee may establish nexus by showing the secondary considerations evidence is the 'direct result of the unique characteristics of the claimed invention,'" *Magseis FF LLC v. Seabed Geosolutions (US) Inc.*,

860 F. App'x 746, 751 (Fed. Cir. 2021) (not for publication) (quoting *Huang*, 100 F.3d at 140), "rather than a feature that was 'known in the prior art,'" *id.* (quoting *Ormco Corp.*, 463 F.3d at 1312). *Magseis FF LLC* distinguishes the "presumption of nexus" from a "nexus in fact," where the latter pertains to what Patent Owner may show is the "direct result of the unique characteristics of the claimed invention" as characterized in *Huang*. *See id.* at 751–52 ("Substantial evidence also supports the Board's finding of no nexus in fact because the evidence of secondary considerations is not tied to the claimed invention's unique characteristics."). To establish a nexus in fact, the proponent must show that a claimed "feature" is "tied" to its "evidence of secondary considerations," as opposed to being, for example, known in the prior art. *See id.* at 752 ("Magseis fails to argue or demonstrate that its other evidence of secondary considerations is linked to a unique characteristic of the claimed invention, as opposed to known features," and "[b]ecause Mattaboni discloses that feature, the alleged skepticism and commercial success are irrelevant.").

"[I]f the unclaimed features amount to nothing more than additional insignificant features, presuming nexus may nevertheless be appropriate." *Fox Factory*, 994 F.3d at 1374. "In this case, however, because there are one or more features not claimed by the '027 patent that materially impact the functionality of the X-Sync products, including the >80% gap filling feature claimed in the '250 patent, nexus may not be presumed." *Id.* at 1376. "We reject SRAM's attempt to reduce the coextensiveness requirement to an inquiry into whether the patent claims broadly cover the product that is the subject of the evidence of secondary considerations." *Id.* at 1377.

Recently, the Federal Circuit indicated that *Fox Factory's* "coextensiveness" requirement is the same as the "commensurate in scope" standard regarding the "presumption of nexus." Specifically, the court held that "the Board determined that Zaxcom's evidence of industry praise and long-felt need was entitled to *a presumption of nexus, noting that these indicia were commensurate in scope with the claims as now narrowed*, . . . a determination that comports with the legal standards for a presumption." *Zaxcom, Inc. v. Lectrosonics, Inc.*, 2022 WL 499843, at *2 (Fed. Cir. 2022) (published only in Westlaw) (citing *Fox Factory, Inc. v. SRAM*, LLC, 944 F.3d 1366, 1373 (Fed. Cir. 2019); *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1072 (Fed. Cir. 2018)) (emphasis added).

Several cases prior to *Fox Factory* address the commensurate in scope requirement, without specifically addressing the presumption of nexus. Together, the cases suggest that coextensiveness, or the reasonably commensurate in scope requirement, requires more than reading the claims onto a product that is the subject of the evidence of secondary considerations, when significant unclaimed features exist. For example, in *MeadWestVaco Corp. v. Rexam Beauty and Closures, Inc.*, 731 F.3d 1258, 1264 (Fed. Cir. 2013), the court held that the district court erred by considering "secondary considerations of non-obvious [that] involved only fragrance-specific uses, but the claims now at issue [i.e., claims 15 and 19] are not fragrance-specific." The district court erred because it "credited evidence advanced to show long-felt need and commercial success specific to the perfume industry" but some claims at issue "are not limited to fragrance-specific claims." *See id.* at 1264–65 (reasoning that "objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support") (quoting *Ayst Techs., Inc.*

v. Emtrak, Inc., 544 F.3d 1310, 1316 (Fed. Cir. 2008); *see also In re Law*, 303 F.2d 951, 954 (CCPA 1961) ("Thus, assuming the affidavits are a proper showing of commercial success, they do not show commercial success of dockboards covered by the appealed claims which are not limited to the bead of claim 13."); *In re Tiffin*, 448 F.2d 791, 792 (CCPA 1971) (finding commercial success and long-felt need with respect to "'cups' used in vending machines" and "agree[ing] with "[t]he solicitor's position . . . that the objective evidence of non-obviousness is not commensurate with the scope of claims 1–3 and 10–16, reciting 'containers' generally, but establishes non-obviousness only with respect to 'cups' and processes of making them").[27]

Patent Owner asserts a "presumptive nexus" (PO Resp. 57) based on commercial success (sales) by Apple of Apple headphones, asserting the "AirPods Products are the 'headphone assembly' of claim 1" (*id.* at 56). Patent Owner refers to different generations of "Airpods TWS earbuds," namely Airpods and Airpods Pro ("AirPods Products"). *Id.* at 52. As evidence of commercial success, Patent Owner relies on public sources to estimate that Petitioner sold 15 million AirPods in 2017; 35 million AirPods in 2018; 60 million AirPods in 2019; and 114 million AirPods in 2020. *Id.* at 53 (citing Ex. 2053, 15). Patent Owner argues that "Apple released the first generation of its AirPods TWS earbuds in December 2016 with an initial sales price of $159." *Id.* at 52 (citing Ex. 2050, 1–3). Patent Owner

[27] To the extent the "commensurate in scope" cases are not directly on point as to presumption of nexus (notwithstanding the indication in *Zaxcom* that they are), we cite them as persuasive authority to show that under similar reasoning, Patent Owner fails to show a presumption of nexus or a nexus, or at most shows a weak nexus.

contends that the "AirPods Products constitute almost 50% of ["over 300 million TWS headsets in 2020"], and asserts that "the market for TWS stereo headsets is growing," "which is an important component of . . . commercial success.'" *Id*. at 43–44 (citing Ex. 2046, 2; last quote quoting *In re Applied Materials, Inc.*, 692 F.3d 1289, 1300 (Fed. Cir. 2012)).

On one hand, Patent Owner argues that nexus exists between the AirPods Products and the "Challenged Claims" (claims 1–22, 32–41, 47, and 49–62). PO Resp. 52. On the other hand, Patent Owner states that "the AirPods Products possess all the elements of claims 1–9, 32–41, 47, 49 and 52–62 of the '934 [p]atent." *Id.* at 53. This latter argument indicates that Patent Owner's showing for nexus pertains only to claims 1–9, 32–41, 47, 49 and 52–62, instead of all of the challenged claims. *See id.*

Patent Owner bases its alleged nexus on a November 6, 2020, infringement claim chart, comparing the AirPods Products to claims 1–9, 32–41, 47, 49, 54, 55, and 52–62 of the '982 patent" (Ex. 2037, 3, 525–595, 597–663), which Patent Owner submitted in a district court lawsuit. PO Resp. 53 (citing Ex. 2037, 525–595 (AirPods Pro), 597–663 (AirPods)). Patent Owner does not provide a detailed comparison of the AirPods or AirPods Pro with the challenged claims in its Response. *Id*. at 56–59.

Petitioner argues that Patent Owner fails to establish a presumption of nexus, because Patent Owner does not show the coextensiveness between the AirPods Products and the claims. *See* Reply 27–32. Petitioner also argues that Patent Owner does not show the coextensiveness aspect of nexus because Patent Owner improperly incorporates by reference the claim charts and Patent Owner fails to show that the challenged claims even "cover" the asserted AirPods Products. *Id*. at 28–29.

Petitioner also contends that Patent Owner "made no effort to meet its burden to show that AirPods lack unclaimed features responsible for their success." Reply 30. The alleged unclaimed features follow: "'ultra-low power Apple W1 chip'; 'high-quality audio'; 'industry-leading battery life'; 'one-tap setup'; 'flexible ear tips'; 'vent system to equalize pressure'; 'sweat- and water-resistan[ce]'; 'high dynamic range amplifier'; 'force sensor'; '[a]udio [s]haring'; '[a]nnounce [m]essages'; and integration with Apple's ecosystem." *Id.* (quoting Ex. 2050, 3; Ex. 2052, 2–7; citing Ex. 1160 ¶ 76).

Petitioner adds that "Patent Owner's employee [and declarant here,] Mr. Blair[,] admitted that headphones' commercial success is affected by cost, weight, comfort, durability, ease of use, battery life, sound quality, moisture tolerance, and brand name—none of which are claimed." Reply 30–31 (citing Ex. 1147 (Mr. Blair's deposition), 15–20). And critically, Petitioner shows that Mr. Blair "admitted that the Apple brand—obviously unclaimed—drives Apple sales." *Id.* at 30 (citing Ex. 1147 (Mr. Blair's deposition), 20); Ex. 1160 ¶¶ 77–78).

In response, Patent Owner does not address Petitioner's argument that that Mr. Blair "admitted that the Apple brand—obviously unclaimed—drives Apple sales." Reply 30 (citing Ex. 1147, 20; Ex. 1160 ¶¶ 77–78). On the cited page, Mr. Blair supports Petitioner, answering "I would assume that it does" after Petitioner asks him if "the Apple brand name help[s] Apple sell their wireless headphone products?" Ex. 1147, 20:8–11.

Also during his deposition, Mr. Blair characterizes several features of headphones in general as "important" to sales or "a significant concern" for potential headphone consumers or users: "cost," "weight," "comfort," "user interface that's easier to use," "durability," "battery life," "sound quality,"

moisture tolerance ("the ability to use . . . the headphone product, when exercising or sweating"), and "brand name." *See* Ex. 1147, 15–20.

Patent Owner asserts that "the Reply identified several purported unclaimed features, but did not assert that any of them are significant." Sur-reply 23. This is not a fair characterization of Petitioner's argument. As noted above, Petitioner argues that Patent Owner has not shown that "AirPods lack unclaimed features *responsible for their success*," thereby indicating the unclaimed features are significant. Reply 30 (emphasis added). Similarly, relying on the deposition testimony of Mr. Blair, Petitioner argues that "the Apple brand—obviously unclaimed—*drives Apple sales*." *Id.* Petitioner also relies Mr. Blair's deposition testimony as indicating that several features are significant to sales in general as noted above. As also noted above, Mr. Blair testifies that he "assume[s]" that the unclaimed "Apple brand" "helps Apple sell their wireless headphone products." Mr. Blair therefore indicates the Apple brand is significant as an unclaimed feature because it contributes to the AirPods Products' commercial success. As another example, Mr. Blair testifies that "sound quality" is "an important consideration for consumers in buying earphones. Ex. 1147, 19:6–14. And Patent Owner "does not argue that those unclaimed components are insignificant." *See Magseis*, 860 F. App'x at 752 ("Magseis does not argue that those unclaimed components are insignificant.").

Patent Owner describes one of the AirPods Products as "including a different Apple-designed chip (H1 chip) that 'delivers performance efficiencies, faster connect times, more talk time and the convenience of hands-free "Hey Siri."'" PO Resp. 52 (quoting Ex. 2051, 2). Patent Owner also states that "[t]he AirPods Pro add 'Active Noise Cancellation and superior, immersive sound in an all-new lightweight, in-ear design.'" *Id.* at

52–53 (quoting Ex. 2052, 2). Patent Owner's descriptions and Mr. Blair's testimony indicate that these features are significant as contributing to commercial success. Patent Owner does not dispute Petitioner's showing that the Airpods Products include the unclaimed features of "high-quality audio," a "high dynamic range amplifier," and the "ultra-low power Apple W1 chip." *See* Reply 30. Patent Owner also does not describe how the challenged claims are coextensive (or reasonably commensurate in scope) with these features. *See* PO Resp. 56–58 (discussing claim 1 without any mention of superior noise quality, high dynamic range amplifier, or HI chip features), 58–59 (same as to Signal Strength claims), 59 (same as to claims 34–41).

Claims 56 and 57 recite "a digital signal processor that provides a sound quality enhancement." Patent Owner does not assert that the recited DSP and its sound quality function are reasonably commensurate in scope with the AirPods Products "ultra-low power Apple W1 chip," "high-quality audio" and a "high dynamic range amplifier." *See* PO Resp. 56–59. Apple merely provides a claim chart, as noted above. Even if the claim chart is properly incorporated by reference in the Response, the claim chart does not point to a DSP in its allegation of infringement of claim 56. Ex. 2037, 579.[28] For these reasons, the challenged claims are not reasonably commensurate in scope with Patent Owner's evidence, which pertains to significant unclaimed features such as the AirPods Products "ultra-low

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[28] The claim chart refers to https://www.apple.com/airpods-pro/, but we decline to further investigate what amounts to an improper incorporation by reference that, in turn, incorporates additional evidence not in the record. *See* Ex. 2037, 579.

power Apple W1 chip," "high-quality audio" and a "high dynamic range amplifier."

In addition, claims 56 and 57 (or any challenged claim) do not require what Apple's literature (as provided by Patent Owner) describes as a "high dynamic range amplifier" and "high-quality audio," even if the claimed "sound quality enhancement" (which may only involve "noise cancellation," *see* Ex. 1001, 7:35) somehow relates to Apple's "high-quality audio." *See* Reply 30 (citing Ex. 2050, 3; Ex. 2052, 2–7; Ex. 1160 ¶ 76); Ex. 2050, 3 ("The revolutionary experience is enabled by new ultra-low power Apple W1 chip, which enables AirPods to deliver high-quality audio and industry-leading battery life in a completely wireless design."); Ex. 2052, 2 ("The new in-ear AirPods Pro sound amazing with Adaptive EQ, fit comfortably with flexible ear tips and have innovative Active Noise Cancellation and Transparency mode."), 4 (describing two microphones for external and internal noise cancellation, wherein "[n]oise cancellation continuously adapts the sound signal 200 times per second," and describing "[a] custom high dynamic range amplifier [that] produces pure, incredibly clear sound while also extending battery life, and powers a custom high-excursion, low-distortion speaker driver designed to optimize audio quality and remove background noise" for "superior sound quality"). For similar reasons, Patent Owner also does not show how the claimed generic "processor" as recited in claims 1–22, 32–41, 47, 49–55, and 58–62, or the DSP as recited in claims 56 and 57, is reasonably commensurate in scope with Apple's "new ultra-low power Apple W1 chip, which enables AirPods to deliver high-quality audio and industry-leading battery life." *See* Ex. 2050, 3.

As another example, Patent Owner does not address Petitioner's showing that Apple's headphones provide "sweat- and water-resistan[ce],"

another unclaimed feature. *See* Reply 30; Ex. 2052, 3 ("AirPods Pro are sweat and water-resistant, making them perfect for active lifestyles."). Mr. Blair deems "durability" a "significant consideration to customers," which generally indicates that "sweat- and water-resistan[ce]" is a significant unclaimed feature—otherwise water might damage the headphones and alter their durability. *See* Ex. 1147, 18:10–15.

Mr. Blair mentions other important features that contribute to commercial success for generic headphones: "user interface that's easier to use," "weight," "comfort," and "battery life." *See, e.g.*, Ex. 1147, 19:15–18 (indicating in response to a question that "the ease or difficulty of setting up and using the product" is "[c]ertainly" "important to consumers"). Patent Owner's Exhibit 2052 indicates that the AirPod Pros includes improved battery life, low weight, ease of use, and comfort, as the following evidence shows: "AirPods Pro deliver up to four and a half hours of listening time and up to three and a half hours of talk time on a single charge." Ex. 2052, 6. "Switching between Active Noise Cancellation and Transparency modes is simple and can be done directly on AirPods Pro using a new, innovative force sensor on the stem. The force sensor also makes it easy to play, pause or skip tracks, and answer or hang up phone calls." *Id.* at 5.

> AirPods Pro take it even further with a new class of lightweight, in-ear headphones engineered for comfort and fit. Each earbud comes with three different sizes of soft, flexible silicone ear tips that conform to the contours of each individual ear, providing both a comfortable fit and a superior seal — *a critical factor in delivering immersive sound*. To further maximize comfort, AirPods Pro use an innovative vent system to equalize pressure, minimizing the discomfort common in other in-ear designs.

Id. at 3 (emphasis added).

The challenged claims do not require an interface, a force sensor, a vent system to equalize pressure, or flexible silicone ear tips that conform to each user's ear, all of which the quoted literature above shows are significant features of the AirPods products by rendering them comfortable and easy to use. As Petitioner argues, the challenged claims do not require the Apple features of reduced "weight," "comfort," "ease of use," "flexible ear tips," features that Mr. Blair indicates are important in commercial success. *See* Reply 30–31 (citing Ex. 1147, 15–20).

Patent Owner also does not show how the claimed "rechargeable battery" is reasonably commensurate in scope with the AirPods Products' "industry-leading battery life" bringing "up to four and a half hours of listening time." *See* Reply 30–31 (listing battery life as an unclaimed feature that contributes to commercial success). Mr. Blair testifies that "[l]onger [battery life] is more desirable," and longer life "increases the likelihood that [consumers will] purchase the headphone." *See* Ex. 1147, 18:2–9. In summary, Patent Owner's evidence, including the testimony of Mr. Blair, indicates that many of the unclaimed features, separately or collectively, as cited by Petitioner, are significant to the commercial success of the AirPods Products. As noted above, Patent Owner bears the burden of showing a presumption of nexus or a nexus in fact.

Petitioner provides other evidence tending to show that the claimed features do not contribute to commercial success, arguing that "[t]he irrelevance of the claims to commercial success is confirmed by the failure of Koss's own Striva earbuds—which Koss argues practiced the '934 patent." Reply 30 (citing Ex. 1153, 1; Ex. 1147, 22–30; Ex. 1154, 6). Patent Owner does not dispute Petitioner's argument and evidence that Koss's Striva earbuds embodied by the claims lack commercial success. Sur-reply

24 (arguing "Petitioner cited no cases" for its "novel theor[y]" that "all products that practice the claims must be commercially successful"). Petitioner's showing in this regard corroborates its showing that the Apple brand is a significant unclaimed feature, and/or, like Apple's marketing, contributes to the success of the AirPods Products.

At least for the reasons above, Patent Owner does not meet its burden of showing the requisite nexus via a presumption— that the AirPods or AirPod Pro embodies "the claimed features, and is coextensive with them." *Fox Factory*, 944 F.3d at 1373. Patent Owner's central basis for asserting that the AirPods Products embody the claims is a claim chart from a separate litigation. Ex. 1014, 1003–1014, 1041–1052. At most, this might show that the challenged claims cover the AirPods Products. *See Fox Factory*, 944 F.3d at 1377 ("We reject SRAM's attempt to reduce the coextensiveness requirement to an inquiry into whether the patent claims broadly cover the product that is the subject of the evidence of secondary considerations.").

Moreover, the challenged claims recite a headphone assembly. However, Patent Owner contends that its Response "explained why the AirPods, when combined with an iPhone and in communication with the Apple server system, possess all the elements of independent claims 1 and 58." Sur-reply 23. Patent Owner also alleges that "the AirPods Products integrate into the *Apple ecosystem* by pairing with a mobile DAP (e.g., an iPhone); initiate transmission of request to a remote, network-connected server (e.g., an Apple server that provides voice assistant (e.g., Siri) services); and receive firmware updates from the server." PO Resp. 53 (emphasis added).

This line of argument supports Petitioner. It shows that the whole "Apple ecosystem," which, according to Patent Owner, at the least includes

Airpods Products, Apple iPhones, and an "Apple server," with the Apple support system providing features such as "voice assistant" and "firmware upgrades," drives the Airpod Product's success. *See* PO Resp. 54; Sur-reply 23. And as noted above, Mr. Blair agrees that the Apple brand (which includes its "ecosystem") is an important factor in the AirPod's commercial success. As Petitioner argues, "integration with Apple's ecosystem" is an unclaimed feature. Reply 30 (citing Ex. 2050, 3; Ex. 2052, 2–7; Ex. 1160 ¶ 76). Patent Owner also indicates that Apple's marketing is important by arguing that "Apple also specifically markets the Siri integration of the AirPod Products." PO Resp. 57.

In contrast, the "headphone assembly" as recited in the challenged claims do not require an "Apple ecosystem" or any other single source ecosystem, Apple marketing, or Siri—the challenged claims only require a headphone assembly broadly configured to communicate to a generic DAP and a server. The challenged claims do not require any ease of use features for fostering this communication, which Mr. Blair generally deems important to commercial success, as discussed above. These generic DAP and server components, which amount to intended use of the headphone assembly with a generic DAP or server are not necessarily part of an "ecosystem" of a single company (like Apple) that services all of the disparate components, including by providing technical support, marketing, processing of firmware upgrades, or otherwise (according to Patent Owner's arguments).[29]

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[29] This intended use of the recited server and DAP in the challenged claims at most impart some structure/functionality to the headphone assembly, rendering it capable of communication with the server and DAP as recited. *See supra* II.C (Claim Construction).

Specifically with respect to firmware upgrades, limitation 1E recites "a memory for storing firmware that is executed by the processor," and limitation 1K recites "wherein the headphone assembly is for receiving firmware upgrades transmitted from the remote, network-connected server." Comparing the two clauses reveals that the challenged claims do not require execution/processing of the firmware upgrades (or even the capability to execute/process upgrades). Patent Owner agrees. *See* Tr. 92:17–93:25 (agreeing that claim 1 does not require executing firmware upgrades).

In contrast, Patent Owner alleges that in the Apple ecosystem, "[f]irmware updates are needed to keep electronic devices like the AirPods Products *operating reliably by fixing bugs* and to introduce new features." PO Resp. 57 (emphasis added). In addition, Patent Owner stresses that "[w]ithout the firmware updates, *the bugs could not be fixed and new features could not be added*. . . . Consequently, *the products would not have had significant sales*." *Id.* at 58 (emphasis added).

Stated differently, the challenged claims are not reasonably commensurate in scope with (not coextensive with), the Apple ecosystem evidence, including with respect to the firmware upgrades, because Patent Owner proffers evidence and/or argument specific to the processing of firmware upgrades, showing the unclaimed feature is significant, but the challenged claims do not require the capability to process firmware upgrades (even if the challenged claims cover such processing). And Patent Owner stresses that processing of firmware upgrades is critical to sales, as found above. In other words, the unclaimed feature of processing of firmware upgrades is significant, according to Patent Owner's arguments and evidence, thereby showing a lack of a presumption of nexus. *Cf. Fox Factory*, 944 F.3d at 1374) ("[I]f the unclaimed features amount to nothing

more than additional insignificant features, presuming nexus may nevertheless be appropriate."); *Zaxcom*, 2022 WL 499843, slip. op at *2 (holding that "a presumption of nexus" arises from showing that proffered "indicia were commensurate in scope with the claims" (citing *Fox Factory*, 944 F.3d at 1373; *Polaris Indus.*, 882 F.3d at 1072)).

Viewed another way, in *MeadWestVaco*, even the capability of dispensing a perfume in a generic dispenser claim is not enough to show a nexus to fragrance-specific (e.g., perfume dispensing) products. *See MeadWestVaco*, 731 F.3d at 1262–64. Similarly, "for *receiving* firmware upgrades" as limitation 1K recites is not reasonably commensurate in scope with the evidence that Apple's AirPod Products *process* firmware upgrades, which is a significant component of its commercial success, according to Patent Owner's evidence and arguments as described above. Patent Owner need not always show "objective evidence of nonobviousness for every potential embodiment of the claim." *See Rambus*, 731 F.3d at 1257 (citing *In re Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011) ("Objective evidence of nonobviousness need only be 'reasonably commensurate with the scope of the claims,' and we do not require a patentee to produce objective evidence of nonobviousness for every potential embodiment of the claim." (quoting *Kao*, 639 F.3d at 1068)); *ClassCo*, 838 F.3d at 1221 (reasoning "the Board should have afforded ClassCo's evidence some weight, taking into account the degree of the connection between the [product's] features presented in evidence and the elements recited in the [broad] claims," which encompass the product). However, according to *Fox Factory*, unclaimed significant features indicate a lack of coextensiviness necessary for a presumption of nexus. *Cf. Fox Factory*, 944 F.3d at 1375 ("A patent claim is not coextensive with a product that includes a 'critical' unclaimed feature that is

claimed by a different patent and that materially impacts the product's functionality.").

As indicated above, Patent Owner stresses the importance of fixing bugs by processing firmware upgrades as a *necessary* component of the AirPods Products' commercial success. PO Resp. 58 (arguing that without fixing the bugs, "*the products would not have had significant sales*"). In addition, Patent Owner introduces evidence and argument that "the AirPod Products are specifically designed and marketed to work in the Apple ecosystem with both a smartphone." *Id.* at 57. This specific design of the AirPod Products for use in the "Apple ecosystem" enables Apple's processing of the firmware upgrades so that the AirPod products "operate reliably" after the ecosystem fixes "bugs" and also allows Apple to "introduce new features." *See id.* at 56–57. Therefore, like the generic dispenser claims in *MeadWestVaco* that cover a dispenser containing a perfume but still lack a nexus to commercial success based on a perfume containing dispenser, Patent Owner advances no reason, and none is on record, to infer that merely receiving firmware upgrades without necessarily processing them (or at least requiring the capability for the headphone assembly to process them) would amount to even a small component of the AirPod's commercial success. Not fixing the bugs would result in unreliable products and hinder sales according to Patent Owner. *See* PO Resp. 58. Therefore, at most, any nexus as to this feature is on the weak end of the spectrum.

Similarly, with respect to claims 34–41, Patent Owner argues that "the design of the AirPods Products, with distinct earbuds, body portions and elongated portions, *are important to the commercial success because the elongated portion provides balance and houses the antenna for improve*

wireless reception." PO Resp. 59 (emphasis added). And as Petitioner argues, in another proceeding, IPR2021-00381, Patent Owner similarly asserted a nexus based on similar elongated portions "*extending downward*" as at the "heart" of the invention for the different patent involved there. *See* Reply 31 (emphasis added) (quoting Ex. 1155, 24 ("The heart of the '982 Patent is TWS earbuds with a sleek style, particularly an elongated portion *extending downward* from a body portion, that pairs with a mobile DAP.") (emphasis added)). As Petitioner also notes, *Fox Factory*, 944 F.3d at 1374 holds there is "no nexus where products 'embody the independent claim of a different patent.'" *Id.* (*Fox Factory*, 944 F.3d at 1374).

Patent Owner does not argue or show that an elongated portion in any of the challenged claims either "extend[s] downwards" or "provides balance and houses the antenna for improve wireless reception." *See* Reply 31 (arguing that because the "elongated portions 'extending downwards' (like AirPods) are not in '934 patent claims 1 or 58, [Patent Owner] cannot enjoy a presumption of nexus"). Patent Owner's reliance on the recited "elongated portion" as showing a nexus for narrow claims 34–41 reveal further that broader claims 1 and 58 and other challenged claims dependent therefrom lack a nexus to its evidence. *See MeadWestVaco Corp.* 731 F.3d at 1258 (holding it is error to rely on narrow claims to show a nexus for broader claims that do not require the alleged feature that provides a nexus for the narrower claims); *Tiffin*, 448 F.2d at 792 (holding that evidence of the commercial success of cups does not indicate nonobvious of generic containers).

Other than claims 34–41, the challenged claims fail to even recite an "elongated portion." And although challenged claims 34–41 recite an "elongated portion," they do not recite the significant "extending

downward" feature or the significant feature of the elongated portion providing balance and an antenna. Therefore, these claims also lack a presumption of nexus where Patent Owner stresses that the former feature is the "heart" of its invention and the latter feature is "important to the commercial success" of the AirPods Products. *See* PO Resp. 59; Reply 31 (citing Ex. 1155, 24).

As another example, even if the Airpods and AirPods Pro TWS earbuds that Patent Owner relies on for sales are within the scope of the headphone assembly of claims 1 and 58, these claims are not reasonably in scope with the TWS earbuds evidence. *See* PO Resp. 52–53 (relying on AirPods and AirPod Pro sales evidence); Reply 31–32 ("By defining the AirPods' market as the 'true wireless' market (POR, 55-56), [Patent Owner] implicitly recognizes that AirPods' true-wireless design is important to their success."). For example, Patent Owner contends that "[t]he AirPods Pro add . . . superior, immersive sound in an *all-new lightweight, in-ear design*." *Id.* at 52–53 (emphasis added) (quoting Ex. 2052, 2). As noted above, Patent Owner also relies on sales for "AirPods Products," which "constitute almost 50% of ['over 300 million TWS headsets in 2020']," and asserts that "the market for TWS stereo headsets is growing," "which is an important component of . . . commercial success." PO Resp. at 43–44 (citations omitted). Similar to *Tiffin*, for example, evidence of the commercial success of cups, like the sales of Apple's TWS earbuds, does not show the nonobvious of generic claims to containers or headphone assemblies. *See Tiffin*, 448 F.2d at 792; *see also MeadWestVaco*, 731 F.3d at 1258 (holding it is error to rely on narrow claims to show a nexus for broader claims that do not require the alleged feature that provides a nexus for the narrower claims).

In summary, precedent supports the finding that challenged claims are not coextensive or reasonably commensurate in scope with the specific evidence of secondary considerations based on the Apple ecosystem, processing of firmware upgrades, an elongated portion housing an antenna and providing balance, light-weight, comfortable, durable TWS earbuds providing superior sound and battery life, and other significant unclaimed features described above. The challenged claims do not require these features, each of which, or collectively, Patent Owner stresses are important to the commercial success of the AirPod Products. Patent Owner does not argue, and does not present evidence, to show that the unclaimed features of AirPods Products are insignificant to, or do not materially impact, the AirPods Products. To the contrary, Patent Owner's evidence and arguments indicate that these unclaimed features are significant to Apple's Airpod Product sales, as discussed above. Patent Owner does not show nexus or a presumption of nexus by virtue of the claims being coextensive or reasonably commensurate in scope with the allegedly successful Apple features and system.

With respect to challenged claims 10–22 and 50–51, as indicated above, Patent Owner does not list them in the district court claim chart. In other words, Petitioner fails to show that these claims cover an AirPod or AirPod Pro, precluding a presumption of nexus. Claim 10 recites a "connection wire between the first and second earphones," and claims 11–22 depend therefrom. Claim 50 recites "on-ear speaker elements," and claim 51 recites "over-ear speaker elements." Both claims depend from claim 1. Patent Owner's mere allegation of a nexus fails to show a nexus to the evidence of sales of the AirPod or AirPod Pros, which Patent Owner

describes as "TWS stereo headphones" (i.e., without a wire) and which are earbuds, not "on-ear" or "over-ear."

There is no need to address nexus with respect to the Signal Strength claims, claims 4, 6, 8, 38, 40, 41 and 58–62, given the Majority's holding with respect to these claims. In any event, Patent Owner does not show a nexus or a presumption of nexus. Patent Owner alleges that "the AirPods Products can switch between an iPhone and an Apple Watch, or from an iPad to an iPhone." PO Resp. 58–59 (citing Ex. 2057, Ex. 2058, Ex. 2059). But as Petitioner argues, "nothing in the contentions shows that AirPods perform the cited transition due to signal-strength measurements." Reply 29 (citing Ex. 1160 ¶¶ 70–74). Instead, the switching requires "audio-priority or user-intervention." *Id.* In other words, as Petitioner argues, Patent Owner's claim charts show "the AirPods' ability to switch audio from an iPad to an iPhone when a call is received." *Id.* (citing Ex. 2037, 589, 657). The claim chart supports Petitioner, because it states that "[i]f you finish a phone call on your iPhone and pick up your iPad to watch a movie, AirPods automatically switch over." Ex. 2037, 589. A user ending the call manually and transferring to another source based on the end of the call is not a transition based on signal strength. Accordingly, as Petitioner argues, "[t]here can be no presumption of nexus [with respect to the Signal Strength claims] because [Patent Owner] failed to establish the prerequisite that claim . . . 58 covers AirPods." Reply 29.

As discussed above, Patent Owner may still show nexus, or "nexus in fact," by showing that the commercial success of AirPods Products is the direct result of the unique characteristics of the claimed invention. *See Fox Factory*, 944 F.3d at 1373–1374; *Huang*, 100 F.3d at 140; *Magseis FF LLC* 860 F. App'x at 751 (indicating that the nexus inquiry, *inter alia*, deals with

whether the relied-upon features are in the prior art). Although Patent Owner cites case law regarding nexus based on unique characteristics of the claimed invention, it does not argue what the characteristics are or provide supporting evidence. *See* PO Resp. 53–55 (citing *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988); *Fox Factory*, 994 F.3d at 1373–1374). In addition, as discussed above, Patent Owner's evidence and argument indicate that the Apple brand and marketing are significant unclaimed "economic and commercial factors . . . unrelated to the quality of the" "unique characteristics of the claimed invention." *See Huang*, 100 F.3d at 140 ("In order to establish a proper nexus, the patent owner must offer proof that the sales were a direct result of the unique characteristics of the claimed invention—as opposed to other economic and commercial factors unrelated to the quality of the patented subject matter."); PO Resp. 54 (quoting *Huang*, 100 F.3d at 140).

In summary, Patent Owner does not meet its burden to show a presumption of nexus or show a nexus to its alleged commercial success. Even if there is some nexus, it is weak. Weighing the evidence and arguments presented, we determine that Petitioner shows by a preponderance of evidence that the challenged claims would have been obviousness even if there is a weak nexus to commercial success.

III. CONCLUSION[30]

For the reasons discussed above, Petitioner has shown by a preponderance of the evidence that claims 1–22, 32–41, 47, and 49–62 of the ’982 patent are unpatentable as summarized in the table below.[31]

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–3, 5, 7, 9–11, 32–37, 39, 47, 49, 51–57	103	Schrager, Goldstein,	1–3, 5, 7, 9–11, 32, 33, 47, 49, 51–57	
4, 6, 8, 12, 13, 38, 40, 41, 58–62	103	Schrager, Goldstein, Harada		4, 6, 8, 12, 13, 38, 40, 41, 58–62
14–16, 19, 21, 49–51	103	Schrager, Goldstein, Skulley	14–16, 19, 21, 49–51	
17, 18, 20, 22	103	Schrager, Goldstein, Skulley, Harada		17, 18, 20, 22
1–3, 5, 7, 9–11, 14–16, 19, 21, 47, 49–53	103	Rezvani-446, Rezvani-875, Skulley, Hind	1–3, 5, 7, 9–11, 14–16, 19, 21, 47, 49–53	

[30] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding.* *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. §§ 42.8(a)(3), (b)(2).

[31] We do not reach claims 34–37 and 39 under the obviousness ground based on Schrager and Goldstein.

4, 6, 8, 12, 13, 17, 18, 20, 22, 58–62	103	Rezvani-446, Rezvani-875, Skulley, Hind, Harada		4, 6, 8, 12, 13, 17, 18, 20, 22, 58–62
32–37, 39, 54–57	103	Rezvani-446, Rezvani-875, Oh, Hind	32–37, 39, 54–57	
38, 40, 41	103	Rezvani-446, Rezvani-875, Oh, Hind, Harada		38, 40, 41
Overall Outcome			1–3, 5, 7, 9–11, 14–16, 19, 21, 32–37, 39, 47, 49–57	4, 6, 8, 12, 13, 17, 18, 20, 22, 38, 40, 41, 58–62

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown that challenged claims 1–3, 5, 7–11, 14–16, 19, 21, 32–37, 39, 47, and 49–57 are unpatentable;

FURTHER ORDERED that Petitioner has not shown that challenged claims 4, 6, 8, 12, 13, 17, 18, 20, 22, 38, 40, 41, and 58–62 are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BOSE CORP.,
Petitioner,

v.

KOSS CORP.,
Patent Owner.

IPR2021-00680
Patent 10,469,934 B2

EASTHOM, *Administrative Patent Judge,* dissenting-in-part.

I respectfully dissent from the Majority opinion regarding the Signal Strength claims as outlined in Sections II.F2, II.H, and II.J above (i.e., the Harada-based grounds). The Majority reasons that Harada does not teach transitioning between digital audio sources and even if it does, there is an insufficient reason to apply Harada's teachings to the Schrader, Goldstein headphones under Grounds IB and ID, or the Rezvani-446, Rezvani-875, Skulley, and Hind headphones under Grounds 2B and 2D. The Majority reasons that

> Petitioner does not identify where Harada teaches transitioning from one generic data source to another. Petitioner's citations (Pet. 42–46 (citing Ex. 1098 ¶¶ 11, 14–16, 20, 23, 25, 31, 78, 85, 145–147)) at most show selecting one or more devices to connect to, from a set of registered devices, based on factors such as registered priority, signal strength, and remaining battery power.

In my view, the showing that the Majority describes above is a showing of transitioning based on signal strength, when viewed with the Petition's cited evidence and explanations. The Petition shows that Harada's technique simply automates receiving a signal from a registered source before losing the signal from another registered source. Pet. 42–46. The Petition applies Harada's technique to headphones. *See id.* Imagine a car radio tuned to a radio station while the driver travels across country. As the car travels farther from the station, the received signal becomes noisy (i.e., the signal to noise ratio increases) and the radio drops the station and the user hears noise. Eventually, the car drives into the range of another station and the radio picks up a clear signal. Harada's technique simply automatically transitions between electronic sources based on received signal strength. *See id.* at 42 (citing Ex. 1098, code (57), ¶¶ 16, 23, 78, 85, 145–147; Ex. 1003 ¶¶ 204–206).

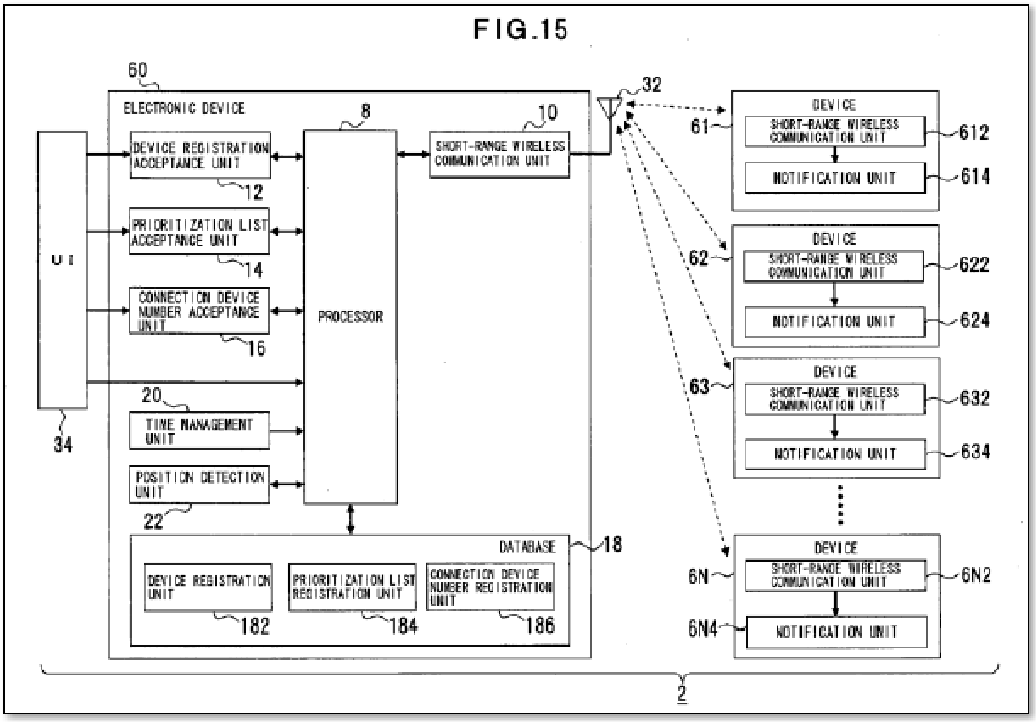
The Petition notes at the outset that Harada discloses a technique for "***any device[]*** equipped with [a] short-range wireless communication function" (*e.g.*, Bluetooth) to "dynamically select[] one or more [available] devices" "having the highest availability." Pet. 42 (citing Ex. 1098, code (57), ¶¶ 16, 23, 78, 85, 145–147; Ex. 1003 ¶¶ 204–206) (alterations in original). Cited paragraph 23 of Harada supports the Petition and states that "*the electronic device can be any devices* equipped with the short-range communication function and can connect with the device having the highest availability." Ex. 1098 ¶ 23. Any electronic device that includes short-range wireless communication at least suggests "Schrager-Goldstein's headset," which like Harada's device, "supports multiple short-range communication standards." *See* Pet. 44 (citing Ex. 1003 ¶ 213; Ex. 1098 ¶¶ 23, 145–147).

As the Petition explains, "Harada's technique would have provided Schrager-Goldstein's headset a technique to connect *to an alternative audio source* (e.g., Goldstein's server, handset, or other headset) *when the connection to the previous source (e.g., Schrager's base unit) was lost/poor (e.g., because it moved out-of-range or its batteries died*)," thereby "*identifying alternative sources based on signal strength*." *See* Pet. 43–44 (citing Ex. 1098 ¶¶ 16, 20, 31; Ex. 1003 ¶¶ 210–211) (emphasis added). In other words, similar to automating a car's reception of a different radio station as it travels between radio stations and loses signal strength, Harada's technique allows "Schrager-Goldstein's headset . . . to connect to an alternative audio source . . . *when the connection to the previous source (e.g., Schrager's base unit) was lost/poor (e.g., because it moved out-of-range* or its batteries died)." *See id.* (emphasis added).

The Petition relies on "Figure 15" of "Harada." Pet. 42. The Petition states that "Harada's device includes 'a registration unit' (to "impart[] priorities to the plurality of devices and register[] a prioritization list") and a "control unit" (e.g., "processor" to "*dynamically select*[] one or more devices based on the prioritization list"). *Id.* (emphasis added) (alterations in original). The Petition states that "[e]xemplary 'dynamic information [used] as a selection factor' include "*the received signal level of the short-range wireless communication function between device[s]*." *Id.* (emphasis added, second two alterations in original)) (citing Ex. 1098 ¶¶ 11, 25). In other words, this dynamic selection, based on received signal level, is the transitioning of the Signal Strength claims, as explained further below.

Harada's Figure 15 clearly shows two-way transmission (a "communication function" (Ex. 1098 ¶ 11)) between all types of short-range

wireless electronic devices. *See* Pet. 43 (reproducing Harada's Fig. 15). Figure 15 of Harada follows:



Harada's Figure 15 above illustrates information flowing in both directions (with arrows) between electronic device 60 on the left and one or more user-registered electronic devices on the right, 61–6N. *See* Pet. 42–44; Ex. 1098, Fig. 15, code (57). The Petition states that "*like* Harada's device, Schrager-Goldstein's headset has multiple audio sources from which to receive audio . . . and Harada's technique is "useful for giving *and receiving information*" from multiple sources by "enhanc[ing]" "the credibility of the connection" to the selected source." Pet. 43 (emphasis added, second alteration in original) (quoting Ex. 1098 ¶ 16). In other words, Harada is "like" Schrager-Goldstein in that both teach that a short-range electronic device can receive information from multiple sources, with Schrager-Goldstein explicitly teaching receiving digital audio from one or more

digital audio sources according to the Petition and the record. *See id.* at 42–46.

The Petition cites Harada's abstract, which describes Figure 15, as follows:

> [t]he present invention is comprised of a communication unit (short-range wireless communication unit 10) for transmitting/*receiving* a short-range *wireless signal* to/*from one or more devices* (devices 61 to 6N) with a short-range wireless communication function, a registration unit (database 18) for adding priorities to the plurality of the devices . . . , and a control unit (processor 8) for *dynamically selecting one* or more *devices* based on the prioritization list.

Ex. 1098, code (57). The abstract, cited by the Petition, introduces Harada's dynamic selection (i.e., transitioning) technique of multiple sources in a prioritization list. Cited paragraph 11 of Harada further describes the transitioning introduced in the abstract. It describes "improv[ing] availability of a device by *referring to dynamic information as a selection factor*, *such as a received signal level of the short-range wireless communication function between devices*." Ex. 1098 ¶ 11; *see* Pet. 42 (citing Ex. 1098 ¶¶ 11, 15). The Petition relies on this citation, and Dr. Williams, who quotes Harada to explain how Harada's dynamic selection technique is a transitioning technique. *See* Pet. 42 (citing Ex. 1003 ¶¶ 207–209). At the cited paragraphs, Dr. Williams explains that Harada's "selection is 'dynamic' because *the device* can select a connection destination based on 'priorities set in advance but also dynamic information *such as a received signal level* and a position' so that '*the device* with higher availability for the user can be connected depending on position of user and form of action.'" Ex. 1003 ¶ 208 (quoting Ex. 1098 ¶ 31) (emphasis added). Dr. Williams further explains that "[a]n example of 'dynamic information

[used] as a selection factor' is '[the] received signal level of the short-range wireless communication function between *devices*.'" *Id.* ¶ 209 (emphasis added, second two alterations in original) (quoting Ex. 1098 ¶ 211). Here, the Petition, and Dr. Williams, rely on generic short-wave devices as described in Harada.

The Petition relies on modifying "Schrager-Goldstein's headset," which receives digital audio information, and reasons that "it would have been using a known technique (Harada's device selection technique) to improve *a similar electronic device* in the same way (e.g., by enhancing the device's connection to audio sources and/or identifying alternative sources based on signal strength when another's battery died)." Pet. 44 (citing Ex. 1003 ¶ 212; Ex. 1107 ¶ 7) (emphasis added).[32] The Majority appears to reason that because Harada does not explicitly discuss digital audio or the capability of headphones to transition between digital audio sources, Harada's electronic device connection technique cannot improve Schrager-Goldstein's similar electronic device (i.e., a headset) based on signal strength. However, there is no dispute that Schrader-Goldstein's headset receives digital audio information from one or more digital audio sources without any teaching from Harada. And there is no dispute that Harada teaches generic short-wave electronic devices for its dynamic scheme. As summarized above, the Petition relies on Harada's technique to modify the digital audio receiving headphones of Schrader-Goldstein so that they can dynamically transition to another digital audio source that Schrader-Goldstein also discloses. *See* Pet. 42–46.

[32] The Petition presents a similar showing under Grounds 2B and 2D, relying on Harada to modify the headphones of Rezvani-446, Rezvani-875, Skulley, Hind, and/or Oh. *See* Pet. 82–87, 95–96.

Like a car radio, when a headset travels out of range of its audio source, with or without Harada's technique, it no longer is able to process decipherable audio from that source because there is simply insufficient power. Harada's technique simply allows the Schrager-Goldstein headphones to receive audio from a stronger signal source that the user registers. *See* Pet. 42–46. Petitioner shows that this is an improvement for Schrager-Goldstein's similar digital audio receiving headphones, by applying Harada's well-known technique—improving Schrager-Goldstein's headphones so that they receive audio from a registered device when the headphones are out of range of the original audio source or otherwise lose a signal based on diminished battery power. *See id.* at 43–44 ("Harada's technique would have provided Schrager-Goldstein's headset a technique to connect to an alternative audio source (e.g., Goldstein's server, handset, or other headset) when the connection to the previous source (e.g., Schrager's base unit) was lost/poor (e.g., because it moved out-of-range or its batteries died).")

The Majority envisions possible "disorienting and undesirable" drawbacks in Harada's technique, reasoning that

> it is not clear (even in hindsight) why transitioning from one audio source to another as a user walks from place to place would be an improvement. For example, it might be disorienting and undesirable to switch from a cellular telephone to a music-playing device when the signal from the music-playing device becomes stronger.

The Majority assumes that an artisan of ordinary skill would have viewed each of Harada's sources 61–6N in Figure 15 as different types of sources. But a user of Harada's scheme easily can register two similar sources that provide the same or similar information that a user desires,

especially where Figure 15 depicts the sources as having the same capabilities. *See* Ex. 1098, Fig. 15; Pet. 42 (relying on Harada's registration technique). Even if somehow the Petition and Harada are limited to different source types under the Majority view, however, a user also may want to switch to different audio sources to obtain different information, such as the current score of a ball game, to track breaking news, etc. Or if a user does not like the new information, the user can walk back toward the original source or simply wait for the information to change. Harada's scheme provides alternatives. In other words, under Harada's scheme, as relied upon by Petitioner and as noted above, users select what short-wave radio sources of the combination to register, and the showing, like the claims, is agnostic as to whether the combination includes modified Schrager-Goldstein DAPs providing the same or different music (or other audio information). *See* Pet. 42 (citing Ex. 1098 ¶¶ 14–16), 44 (arguing that "Schrager-Goldstein-Harada's headset would have been identical to Schrager-Goldstein's headset, with the addition of Harada's 'registration unit' and related software executed by Schrager's processor to implement Harada's technique for dynamically selecting a device for connection (e.g., base unit, other headsets, Goldstein's server) based on received signal strength").

The Signal Strength claims cover transitioning to any type of digital audio source so that receiving information from different sources is within the scope of the claims, even if some of the information under some instances "might be disorienting" as the Majority reasons. *See Idemitsu Kosan Co., Ltd., v. SFC Co. Ltd.*, 870 F.3d 1376, 1382 (Fed. Cir. 2017) ("Evidence concerning whether the prior art teaches away from a given invention must relate to and be commensurate in scope with the ultimate

claims at issue.”). At most, even if a headphone user does not always obtain the desired audio from a registered source if the original source is no longer in range, the user according to Harada’s technique obtains some audio at that range as opposed to no audio from the original source. “‘[T]he question is whether there is something in the prior art as a whole to suggest the *desirability*, and thus the obviousness, of making the combination,’ not whether there is something in the prior art as a whole to suggest that the combination is the most desirable combination available.” *In re Fulton*, 391 F.3d 1195, 1200 (Fed. Cir. 2004)) (alteration in original) (quoting *In re Beattie*, 974 F.2d 1309, 1311 (Fed. Cir. 1992)).

This is not hindsight, because Harada’s Figure 15, just like the Signal Strength claims, is agnostic as to whether the same or different sources provide the information. *See* Ex. 1098, Fig. 14. So Harada itself supports a reason to combine, even if Harada’s technique includes users who may not like all the information received at the exact time of each transition (and thereafter). *See In re Zhang*, 654 F. App’x 488, 490 (Fed. Cir. 2016) (nonprecedential) (citing *In re Kahn*, 441 F.3d 977, 990 (Fed. Cir. 2006) (Even if “a prior art reference may indicate that a particular combination is undesirable for its own purposes, the reference can nevertheless teach that combination if it remains suitable for the claimed invention.”).

As Dr. Williams testifies, securing a source with a strong signal (before losing another source based on distance) using Harada’s technique enhances the credibility of the connection by providing the least amount of error and highest signal level. *See* Ex. 1003 ¶ 209; Pet. 42 (citing Ex. 1003 ¶¶ 207–209). As Dr. Williams also testifies, when an electronic source loses its battery power or moves out of range of a Bluetooth device (which is about 10 meters), Harada’s device improves convenience to the user by

providing an alternative radio source. *See* Ex. 1003 ¶ 211; Pet. 42–43 (citing Ex. 1003 ¶¶ 210–211). In other words, Dr. Williams's testimony shows that Harada teaches to an artisan of ordinary skill that a strong alternative radio source for at least some users is more desirable than a weak source or no source —i.e., the one the headphones lost because of insufficient power or received signal strength. Harada's technique provides convenience to the user by providing an alternative source with a strong connection, according to Dr. Williams's reading of Harada, and according to the Petition.

The Majority's reasoning relates to potential trade-offs (i.e., the possibility of some users receiving undesired audio versus others receiving desired audio) that are within the scope of the claims. *See Allied Erecting & Dismantling Co. v. Genesis Attachments, LLC*, 825 F.3d 1373, 1381 (Fed. Cir. 2016) ("[A] given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine."). Moreover, the claims preclude receiving the same audio that emanates ultimately *from the same upstream source* (e.g., the same server connected to multiple downstream DAPs all playing the same song from the server) according to a prior related Board decision on institution.[33] Patent Owner does not argue that the headphones, either according to the disclosed '934 patent scheme or the Signal Strength claims, must transition smoothly to the same song playing simultaneously at a different sources. Patent

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[33] *See Apple Inc. v. Koss Corp.*, IPR2021-00693, Paper 11 at 24 (Oct. 13, 2021) (denying institution) ("This is not, however, an example of transitioning between two sources, as required by claim 58. Wire line telephone 37 still is the only source with which headset 10 communicates in this example.").

Owner also does not argue what the Majority posits, namely that the Petition lacks a sufficient reason to implement Harada's technique because it allows for different sources to play different audio resulting in disorienting transitions.

The Petition's rationale also tracks how Patent Owner describes an alleged infringement of the Signal Strength claims. Specifically, in addressing alleged objective indicia of nonobviousness based on an infringement claim chart (*see infra* § II.K), Patent Owner relies on marketing materials by Apple and contends that "AirPods can intelligently and seamlessly switch from a call on your iPhone to listening to music on your Apple Watch." PO Resp. 59 (citing Ex. 2057; Ex. 2058); *see* Ex. 2058, 3 ("If you're signed in with the same Apple ID on your devices, your AirPods will automatically switch from listening to music on your iPad to answering a phone call on your iPhone, for example."). In other words, Patent Owner alleges that Apple's AirPods switch a user from listening to music to entirely different audio on a telephone call based on the incoming call, and that this switching falls within the scope of the Signal Strength claims. *See* PO Resp. 59. This is similar to (but not the same as) Harada's electronic device moving out of range of one registered device and switching to another desired registered device based on received signal strength. *See* Ex. 1098, Figs. 8, 15.

As Petitioner explained during the oral hearing in response to excellent questioning by Judge McKone, Petitioner relies on Dr. Williams's testimony at paragraphs 208 and 209 of his declaration to support its argument about how a headphone user moves and transitions to an alternative source device based on Harada's teachings "so that you maintain the ability to get audio, *even if* it's not the exact same audio transmission."

See Tr. 99:8–25 (emphasis added) (citing Ex. 1003 ¶¶ 207–208); Pet. 42 (citing Ex. 1003 ¶¶ 207–209). Contrary to the Majority's holding, this oral hearing response by Petitioner is timely as part of the normal trial process clarifying issues based on what Petitioner already showed during trial.

At cited paragraph 208, Dr. Williams testifies that

> *as the user moves around, the headset will detect that another device has a stronger availability (e.g., an MP3 player in another room) and the headset can use that information as a factor to automatically switch the connection destination to an alternative device*. Harada, [0016]-[0031], claim 8 (describing various aspects of "automatically connecting with the selected one or more device in short-range wireless communication").

Ex. 1003 ¶ 208 (emphasis added). At cited paragraph 209, Dr. Williams testifies that

> [a] POSA would have understood that the credibility of the connection is enhanced because, all other things being equal, *the connection destination device whose signals are being received at the highest signal level is likely to be the device whose signals will be received most consistently and with the least amount of error*.

Id. ¶ 209 (citing Ex. 1098 ¶ 16) (emphasis added).

As Patent Owner admits, "Harada discloses an 'electronic device' that can transmit and *receive* short-range wireless signals (e.g., Bluetooth signals) to and *from 'destination' devices*." PO Resp. 27 (emphasis added) (quoting Ex.1098, code (57), ¶ 67). As Patent Owner also notes, Harada designates the destination devices as "reference numbers 61, 62, 63, . . ., 6N." *Id.* (citing Ex. 1098 ¶ 67).

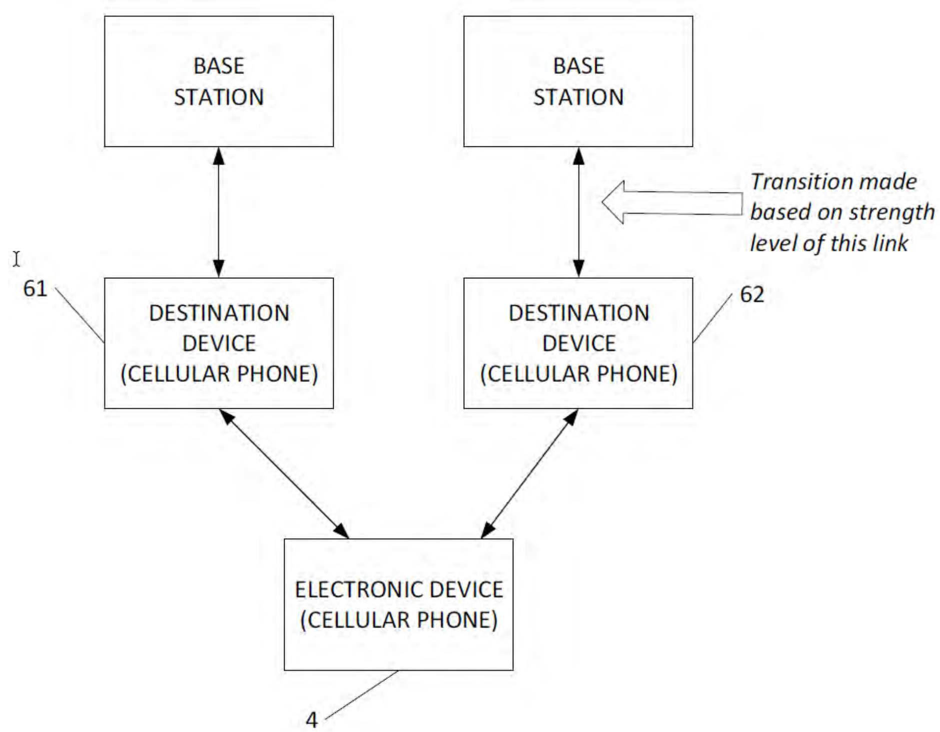
Patent Owner argues as follows:

> Harada's electronic device does not transition from playing digital audio content from a first destination device (e.g., destination device 61 in Harada) to playing digital audio content from a second destination device (e.g., destination device 62 in

> Harada) based on the signal strength level of the wireless communication link between the electronic device and the second destination device (e.g., destination device 62).

PO Resp. 28.

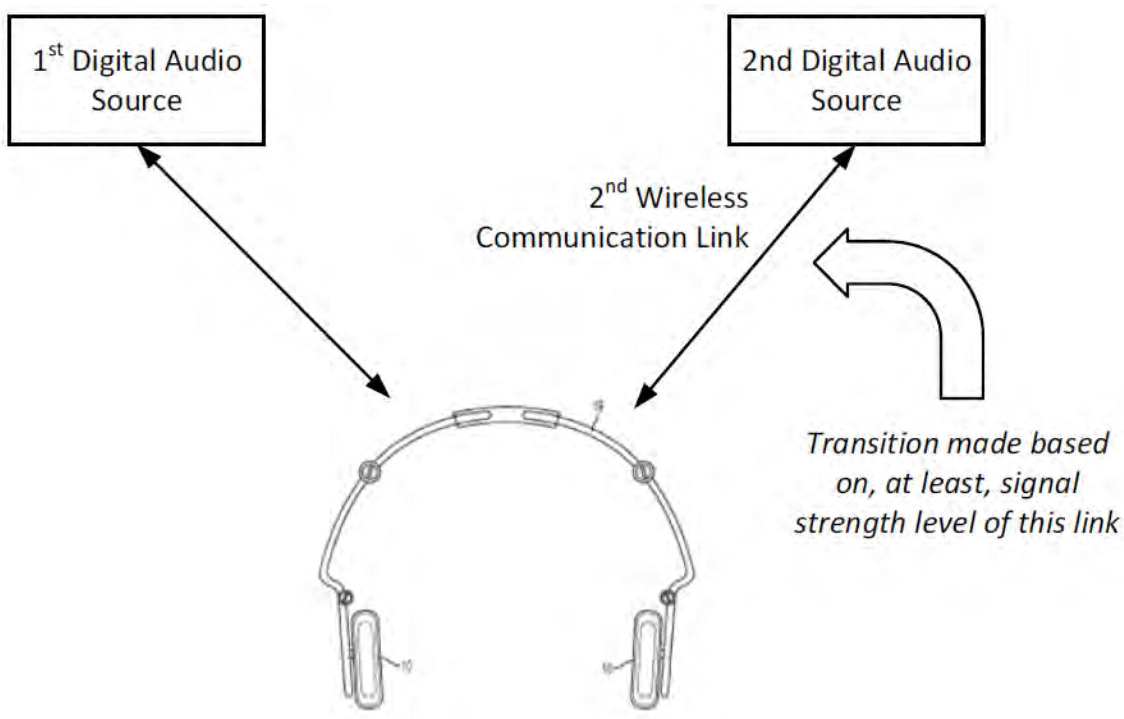
Patent Owner produces the following block diagram to illustrate its argument as to why it contends Harada does not disclose transitioning (PO Resp. 31):



Based on the block diagram above, Patent Owner argues that the designated "link" between a base station and destination device (cellular phone) does not satisfy the Signal Strength claims: "A reason Harada's arrangement transitions based on the signal strength levels *between the destination devices and their corresponding base station* is that Harada's arrangement is for providing the electronic device 4 with a way to make an emergency communication." PO Resp. 31 (emphasis added). In other words, Patent Owner's bases its dispute as to the Signal Strength claims on

an embodiment (with a base station and cellular phone) that Petitioner does not rely upon. The Majority relies on similar base station and cellular phone teachings in Harada (e.g., emergency transmission features) to bolster its holding that Harada does not teach dynamically selecting a source based on received signal strength. However, as noted above, Petitioner relies on Figure 15 and its associated teachings. *See* Pet. 41–44; PO Resp. 30–33; Reply 10–13. And "in a section 103 inquiry, 'the fact that a specific [embodiment] is taught to be preferred is not controlling, since all disclosures of the prior art, including unpreferred embodiments, must be considered.'" *See Merck & Co. v. Biocraft Labs., Inc.*, 874 F.2d 804, 807 (Fed. Cir. 1989) (quoting *In re Lamberti*, 545 F.2d 747, 750 (CCPA 1976)) (alteration in original).

Patent Owner accurately illustrates the Signal Strength claim requirements by way of the following diagram (PO Resp. 29):



The block diagram produced by Patent Owner above is remarkably similar to Harada's Figure 15, because neither one includes a base station or measures signal strength between a device and a base station, and each one illustrates a dynamic selection technique for a short-wave receiving device to switch to an alternative radio source based on the received signal strength at the short-wave receiving device. *Compare* PO Resp. 28, *with* Ex. 1098, Fig. 15. The Petition states that in Harada, "[e]xemplary 'dynamic information [used] as a selection factor' include 'the received signal level of the short-range wireless communication function between device[s].'" Pet. 42 (quoting Ex. 1098 ¶ 11; citing Ex. 1098 ¶ 25) (second two alterations in original).

In its Sur-reply, Patent Owner contends that Harada does not disclose transitioning, which Patent Owner otherwise indicates *is the same as switching*:

> Harada does not disclose an electronic device that *transitions, or switches*, from playing digital audio content received from a first device to playing digital audio content received from a second device based on the signal strength level of the wireless communication link between the electronic device and the second device.

Sur-reply 9–10 (emphasis added) (citing PO Resp. 28); *see also id.* at 10 (arguing that "Harada's ¶[0011], never mentions switching"). However, the Response admits that "Harada's electronic device utilizes a database to implement *the switching technique*." PO Resp. 28 (emphasis added). In other words, Patent Owner recognizes that Harada discloses a switching/transitioning technique.

In any event, as explained above, Petitioner persuasively shows that "Harada discloses numerous pieces of 'dynamic information' as switching

criteria (‘selection factors’),” including a criterion based on “[1] ***a received signal level of the short-range wireless communication function between devices***.” Reply 11–12 (alteration in original) (quoting Ex. 1098 ¶ 11; citing Ex. 1003 ¶ 209; Ex. 1160 ¶¶ 31–34). Similarly, Petitioner shows that Harada’s Figure 8 discloses “switching based on signal strength between a device and destination devices.” *Id.* at 13 (citing Ex. 1098 ¶¶ 103–107, Fig. 8 (step S28)); Ex. 1160 ¶¶ 42–44); *see also* Pet. 42 (relying on Harada’s Figure 15 and paragraph 11 as disclosing dynamic selection of one or more devices based on a “received signal level of the short-range wireless communication function between devices” (quoting Ex. 1098 ¶ 11)), 45–46 (arguing that “Harada’s technique . . . automatically transition[s]” based on signal strength).

The Majority logically does not reach the following arguments by Patent Owner, because they are unnecessary to the Majority’s holding. As indicated above, Patent Owner also argues that “Harada’s *switching technique* relies on a database in the electronic device.” PO Resp. 34 (emphasis added). Based on this database, Patent Owner argues that “because of the smaller battery capacity in wireless headsets, a POSA would not have been motivated to use Harada’s database technique in a headset; the constant database updates would drain the battery such that the wireless headset would have limited time to function as a speaker.” *Id.* at 36 (citing Ex. 2047 ¶ 58). Patent Owner asserts that “[t]his is especially relevant for claims 38, 40 and 41, which are directed to TWS earbuds via dependent claims 32 and 33. Using a battery that can support Harada’s database updates would be even more challenging in a small form factor TWS earbud.” *Id.* (citing Ex. 2047 ¶ 59). In a related argument, Patent Owner also contends that “[a] user would become frustrated if, when the user turned

on the headset, the headset often spent time and battery capacity updating its databases instead of being used for its intended purpose as a speaker." *Id.* at 37. In its Sur-reply, Patent Owner largely repackages its arguments. *See* Sur-reply 11 ("Williams confirmed that Harada's tables are constantly updated over time.").

These arguments do not undermine Petitioner's showing. They largely are not commensurate in scope with the Signal Strength claims, because these claims are agnostic as to updating, battery drain, and any alleged user frustration. *See Idemitsu*, 870 F.3d at 1382 ("Evidence concerning whether the prior art teaches away from a given invention must relate to and be commensurate in scope with the ultimate claims at issue."). Also, Petitioner does not rest its combination on requiring "updating . . . databases" constantly or "when the user turned on the headset," even though Petitioner's combination envisions a database limited to storing device registration information. Petitioner's theory, in line with the claim scope, only requires storage of registration and processing thereof for one or two devices (i.e., devices to which to transition), thereby minimizing memory constraints, battery drain, and user frustration based on updating.

With further regard to claims 38, 40, and 41, which require earbud types of earphones, Patent Owner fails to quantify how "challenging" it would have been to employ known features in a manner undermining Petitioner's showing, given the level of skill involved here, known prior art earbuds, and the scope of the claims, which only require a transition to one device, as indicated above. Also, Petitioner persuasively responds that Harada discloses that its "technique works in watches ([0197]), which had batteries comparable to those in wireless headphones." Reply 14 (citing Ex. 1098 ¶ 197; Ex. 1160 ¶ 49). Although Petitioner relies on modifying

Schrager based on the earbuds of Goldstein (Pet. 35, 45–46), Petitioner notes that Goldstein's earbuds include memory to store data and Goldstein's earbuds include PAA software and a DSP. *See* Pet. 10 (noting Goldstein discloses PAA software to play downloaded audio in an earbud (citing Ex. 1026 ¶¶ 17–19, 24), 16 (citing Goldstein's PAA software and memory (citing Ex. 1026 ¶¶ 65, 82)); Reply 26 (noting Oh's and Goldstein's earbuds include a DSP). Of course, a DSP, and most other circuitry required to process signals and create audio, require a battery and memory. *See* Ex. 1026 ¶¶ 69–70, Fig. 5A, Fig. 5B (describing various circuit components to reproduce audio including batteries in Goldstein's earphones).

Other record evidence shows that implementing batteries in TWS earbuds with DSPs was known, including the patent to Oh, contrary to Patent Owner's similar argument and the testimony of Mr. McAlexander that high heat based on battery problems occur with DSPs in TWS earbuds. *See infra* § II.I.1 (describing Oh's DSP and battery in TWS wireless earbuds teachings); Pet. 87–89 (describing Oh's earbuds including Oh's Fig. 5 showing battery 510 and other circuitry); *supra* § II.D.6 (discussing Patent Owner's similar DSP/battery argument); Reply 26 (noting that "Oh . . . discloses an earbud with a DSP" (citing Ex. 1099 ¶¶ 42–44) and arguing that "[i]ncluding DSPs in true-wireless earbuds was known" (citing Ex. 1160 ¶¶ 52–54); Ex. 1160 ¶ 57 (discussing Ex. 1043 (describing prior art earbud earphones with battery 480, speaker 470, antenna 455, wireless transceiver 450, and "processor 460," which "'includes one or more of amplification circuitry, filtering circuitry, acoustic feedback reduction circuitry, noise reduction circuitry, and tone control circuitry, among other circuits performing signal processing functions as known in the art' (e.g., a digital signal processor)" (quoting Ex. 1043 ¶ 44))).

As Petitioner also argues, "even if Harada's technique reduced battery life or required a momentary update at startup," the obvious combination need not be "the preferred, or the most desirable, combination." *See* Reply 14 (citing *In re Fulton*, 391 F.3d 1195, 1200 (Fed. Cir. 2004)). The challenged claims do not preclude some battery drain and processing of updates. Rather, the claims require the capability to process firmware in limitation 1F. In addition, Petitioner notes that because "the '[934] patent itself describes measuring signal strength and storing connection-related information (Ex. 1001, 10:4[9]–11:[6]), while offering no guidance regarding battery-drain or 'down time,' [this] confirms these are conventional matters." *Id.* (citing Ex. 1160 ¶¶ 45–50; Ex. 1146, 70–76). Finally, an artisan of ordinary skill is not an "automaton." *See id.* (quoting *KSR Int'l v. Teleflex*, 550 U.S. 398, 418–20 (2007)).

There is no evidence of record showing that the resulting combination would have been "uniquely challenging or difficult for one of ordinary skill in the art" or "represented an unobvious step over the prior art." *Leapfrog Enters., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007) (citing *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418–419 (2007)). "The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *KSR*, 550 U.S. at 416. I agree with Petitioner that the Signal Strength claims represent an obvious combination of a known technique applied to a known headphone device, yielding only predictable results.

In my view, for the reasons outlined above, the record shows that the Petition provides reasonable and detailed explanations, supported by the testimony of Dr. Williams and Dr. Casali, indicating how and why the Signal Strength claims would have been obvious. *See* Pet. 47–49, 49–50,

82–87, 95–96. Petitioner’s showing for claims 4, 6, 8, 12, 13, 17, 18, 20, 22, 38, 40, 41, and 58–62 is persuasive. *See id.*

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Paper 38
Date: September 13, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BOSE CORPORATION,
Petitioner,

v.

KOSS CORPORATION,
Patent Owner.

IPR2021-00612
Patent 10,206,025 B2

Before PATRICK R. SCANLON, DAVID C. McKONE, and NORMAN H. BEAMER, *Administrative Patent Judges.*

SCANLON, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Bose Corporation ("Petitioner") challenges claims 1–56 of U.S. Patent No. 10,206,025 B2 (Ex. 1001, "the '025 patent"). We have jurisdiction under 35 U.S.C. § 6, and this Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–3, 6, 8, 10–13, 16, 18, 20–22, 25, 27, 29–31, 34, 36, 38–43, 46, 48, and 51–56 of the '025 patent are unpatentable but has not shown by a preponderance of the evidence that claims 4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28, 32, 33, 35, 37, 44, 45, 47, 49, and 50 are unpatentable.

A. Procedural History

Petitioner filed a Petition (Paper 2, "Pet.") requesting an *inter partes* review of the challenged claims. Koss Corporation ("Patent Owner") filed a Preliminary Response (Paper 9). With our authorization, Petitioner filed a Preliminary Reply (Paper 12) and Patent Owner filed a Preliminary Sur-reply (Paper 13).

We instituted a trial as to all challenged claims. Paper 15 ("Decision on Institution" or "Dec. Inst.").

After institution, Patent Owner filed a Patent Owner Response (Paper 20, "PO Resp."), Petitioner filed a Reply (Paper 29, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 33, "PO Sur-reply").

Petitioner relies on the Declaration of Tim A. Williams, Ph.D. (Ex. 1003), the Declaration of John G. Casali, Ph.D., CPE (Ex. 1005), and the Reply Declaration of Tim A. Williams, Ph.D. (Ex. 1152) in support of its contentions. Patent Owner relies on the Declaration of Joseph C. McAlexander III (Ex. 2024) and the Declaration of Nicholas S. Blair (Ex. 2025) in support of its contentions.

An oral hearing was held on June 15, 2022. A transcript of the hearing is included in the record. Paper 37 ("Tr.").

B. Real Parties in Interest

The parties identify themselves as the real parties in interest. Pet. xix; Paper 3, 1.

C. Related Matters

The parties identify the following proceedings as related matters involving the '025 patent:

Koss Corp. v. Bose Corp., Case No. 6:20-cv-00661 (W.D. Tex.);[1]

Koss Corp. v. PEAG LLC, Case No. 6:20-cv-00662 (W.D. Tex.);[2]

Koss Corp. v. Plantronics, Inc., Case No. 6:20-cv-00663 (W.D. Tex.);[3]

Koss Corp. v. Skullcandy, Inc., Case No. 6:20-cv-00664 (W.D. Tex.);[4]

Koss Corp. v. Apple Inc., Case No. 6:20-cv-00665 (W.D. Tex.) ("the Apple Litigation");

Bose Corp. v. Koss Corp., Case No. 1:20-cv-12193 (D. Mass.);

Apple Inc. v. Koss Corp., Case No. 4:20-cv-05504 (N.D. Cal.);

Apple Inc. v. Koss Corp., Case No. 6:21-cv-00495 (W.D. Tex.); and

Koss Corp. v. Skullcandy, Inc., Case No. 2:21-cv-00203 (D. Utah).

Pet. xx–xxi; Paper 3, 1; Paper 7, 1; Paper 8, 2.

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[1] This proceeding has been dismissed. Ex. 1137.
[2] This proceeding has been dismissed. Ex. 1140.
[3] This proceeding has been transferred to the United States District Court for the Northern District of California. Ex. 1139.
[4] This proceeding has been dismissed. Ex. 1138.

In addition, the parties identify the following *inter partes* review proceedings[5] challenging the ’025 patent or patents related to the ’025 patent as related matters:

Bose Corp. v. Koss Corp., IPR2021-00297, filed December 7, 2020, challenging U.S. Patent No. 10,368,155 B2 (final written decision, notice of appeal filed Aug. 1, 2022);

Apple Inc. v. Koss Corp., IPR2021-00305, filed December 15, 2020, challenging U.S. Patent No. 10,506,325 B1 (final written decision, notice of appeal filed Aug. 1, 2022);

Apple Inc. v. Koss Corp., IPR2021-00381, filed January 4, 2021, challenging U.S. Patent No. 10,491,982 B1 (final written decision, notice of appeal filed Aug. 9, 2022);

Bose Corp. v. Koss Corp., IPR2021-00546, filed February 22, 2021, challenging the ’025 patent (institution denied Oct. 8, 2021);

Apple Inc. v. Koss Corp., IPR2021-00592, filed March 2, 2021, challenging U.S. Patent No. 10,469,934 B2 (terminated Aug. 2, 2022);

Apple Inc. v. Koss Corp., IPR2021-00626, filed March 17, 2021, challenging the ’025 patent (institution denied Sept. 30, 2021);

Bose Corp. v. Koss Corp., IPR2021-00680, filed March 17, 2021, challenging U.S. Patent No. 10,469,934 B2;

Apple Inc. v. Koss Corp., IPR2021-00679, filed March 22, 2021, challenging U.S. Patent No. 10,506,325 B1 (institution denied Oct. 12, 2021);

Apple Inc. v. Koss Corp., IPR2021-00686, filed March 22, 2021, challenging U.S. Patent No. 10,491,982 B1 (institution denied Oct. 12, 2021); and

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[5] *Apple Inc. v. Koss Corp.*, IPR2021-00255, filed November 25, 2020, and *Apple Inc. v. Koss Corp.*, IPR2021-00600, filed March 7, 2021, both challenging U.S. Patent 10,298,451 B1, were also pending at the time the Petition was filed. Final written decisions and notices of appeal subsequently have been entered in both of these proceedings.

Apple Inc. v. Koss Corp., IPR2021-00693, filed March 23, 2021, challenging U.S. Patent No. 10,469,934 B2 (institution denied Oct. 13, 2021).

Pet. xx; Paper 3, 1–2; Paper 6, 1–2; Paper 8, 2.

D. The ’025 Patent

The ’025 patent, titled “System with Wireless Earphones,” issued February 12, 2019, with claims 1–56, and claims priority to several applications dating to April 7, 2008.[6] Ex. 1001, codes (45), (54), (60), (63), 1:3–28, 18:2–24:56. The ’025 patent relates to “a wireless earphone that comprises a transceiver circuit for receiving streaming audio from a data source, such as a digital audio player or a computer, over an ad hoc wireless network.” *Id.* at 1:65–2:2. The ’025 patent defines an “ad hoc wireless network” as “a network where two (or more) wireless-capable devices, such as the earphone and a data source, communicate directly and wirelessly, without using an access point.”[7] *Id.* at 3:2–5. In some embodiments there may be two discrete wireless earphones, one in each ear. *Id.* at 3:45–46.

We reproduce Figure 2A of the ’025 patent below.

[6] Petitioner does not assert that any challenged claim is not entitled to the benefit of the earliest claimed priority date. *See* Pet. 2. Therefore, for purposes of this proceeding, we consider the effective filing date of the ’025 patent to be April 7, 2008.

[7] In contrast, the ’025 patent defines an “infrastructure network” as “a wireless network that uses one or more access points to allow a wireless-capable device, such as the wireless earphone, to connect to a computer network, such as a LAN or WLAN (including the Internet).” Ex. 1001, 3:5–10.

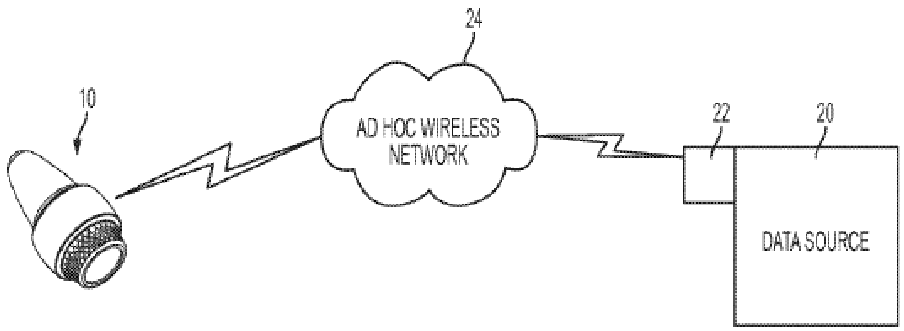

FIG. 2A

Figure 2A illustrates a communication mode for a wireless earphone. *Id.* at 2:27–29, 4:21–24. In particular, Figure 2A shows data source 20 in communication with earphone 10 over ad hoc wireless network 24. *Id.* at 4:24–26. Data source 20 may be a digital audio player ("DAP"), such as an MP3 player, an iPod, or a laptop computer. *Id.* at 4:30–34. "When in range, the data source 20 may communicate with the earphone 10 via the ad hoc wireless network 24 using any suitable wireless communication protocol," including Bluetooth and other communication protocols. *Id.* at 4:54–59.

In one embodiment, earphone 10 connects to network-enabled host server 40 via networks 30a, 42 so that host server 40 can transmit streaming digital audio to earphone 10. *Id.* at 5:54–60, Fig. 2D. Alternatively, host server 40 may transmit to earphone 10 a network address for streaming digital audio content server 70. *Id.* at 5:60–63, Fig. 2D. In this case, earphone 10 uses the received address to connect to content server 70 via networks 30a, 42 and receive digital audio from content server 70. *Id.* at 5:64–67. Content server 70 may be an Internet radio station server. *Id.* at 6:1–2. In addition, content server 70 may stream digital audio that it has received from data source 20 via networks 30b, 42. *Id.* at 6:5–11.

Figure 3, reproduced below, depicts earphone 10 in more detail.

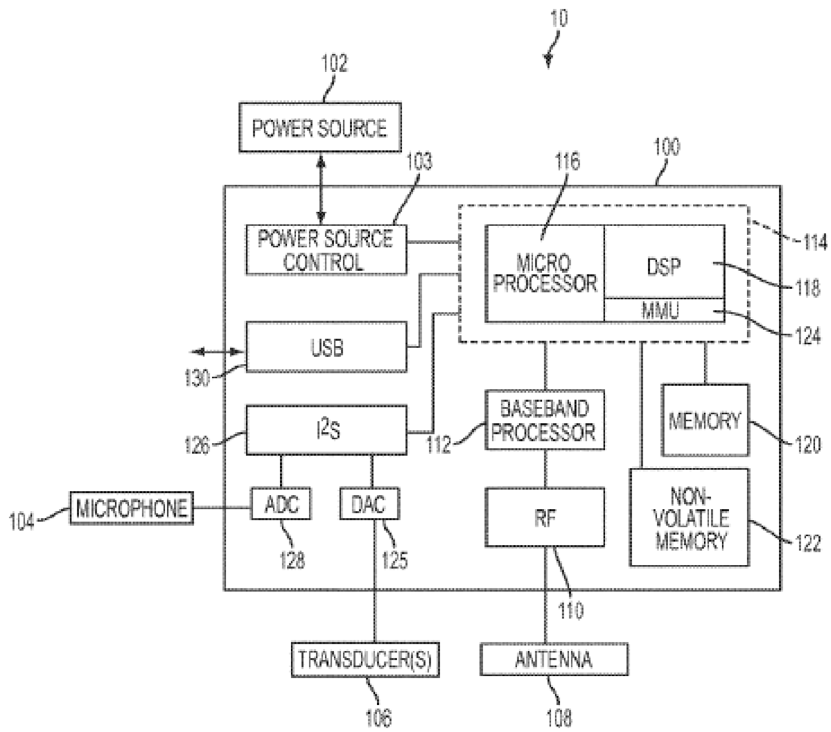

FIG. 3

Figure 3 is a block diagram of a wireless earphone. *Id.* at 2:30–31, 6:26–27. Earphone 10 includes transceiver circuit 100, power source 102, microphone 104, acoustic transducer 106 (e.g., a speaker), and antenna 108. *Id.* at 6:27–33. Transceiver circuit 100, power source 102, and acoustic transducer 106 may be housed within the body of earphone 10. *Id.* at 6:33–36. Microphone 104 and antenna 108 are external to the body. *Id.* at 6:36–38.

E. Challenged Claims

Petitioner challenges claims 1–56 of the ’025 patent, of which claim 1 is the sole independent claim. Claim 1 is reproduced below:

1. A system comprising:

a mobile, digital audio player that stores digital audio content; and

a headphone assembly, separate from and in wireless communication with the mobile digital audio player, wherein the headphone assembly comprises:

first and second earphones, wherein each of the first and second earphones comprises an acoustic transducer;

an antenna for receiving wireless signals from the mobile, digital audio player via one or more ad hoc wireless communication links;

a wireless communication circuit connected to the at least one antenna, wherein the at least one wireless communication circuit is for receiving and transmitting wireless signals to and from the headphone assembly;

a processor;

a rechargeable battery for powering the headphone assembly; and

a microphone for picking up utterances by a user of the headphone assembly; and

a remote, network-connected server that is in wireless communication with the mobile, digital audio player;

wherein the mobile, digital audio player is for transmitting digital audio content to the headphone assembly via the one or more ad hoc wireless communication links, such that the digital audio content received by the headphone assembly from the mobile, digital audio player is playable by the first and second earphones; and

wherein the processor is for, upon activation of a user-control of the headphone assembly, initiating transmission of a request to the remote, network-connected server.

Ex. 1001, 18:2–33.

F. Instituted Grounds of Unpatentability

We instituted *inter partes* review of the challenged claims based on the following grounds of unpatentability asserted by Petitioner:[8]

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–3, 6, 8, 11–13, 16, 18, 20–22, 25, 27, 39, 52, 54–56	103(a)	Rezvani-446,[9] Rezvani-875,[10] Skulley[11]
4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28	103(a)	Rezvani-446, Rezvani-875, Skulley, Harada[12]
10, 38	103(a)	Rezvani-446, Rezvani-875, Skulley, Hind[13]
29–31, 34, 36, 53	103(a)	Rezvani-446, Rezvani-875, Skulley, Davis[14]
32, 33, 35, 37	103(a)	Rezvani-446, Rezvani-875, Skulley, Davis, Harada
40–43, 46, 48	103(a)	Rezvani-446, Rezvani-875, Skulley, Davis, Oh[15]
44, 45, 47, 49, 50	103(a)	Rezvani-446, Rezvani-875, Skulley, Davis, Oh, Harada
51	103(a)	Rezvani-446, Rezvani-875, Skulley, Davis, Oh, Hind

[8] The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. § 103. Because the ’025 patent has an effective filing date before the March 16, 2013, effective date of the applicable AIA amendments, we apply the pre-AIA version of 35 U.S.C. § 103.
[9] US 2007/0136446 A1, published June 14, 2007 (Ex. 1097).
[10] US 2007/0165875 A1, published July 19, 2007 (Ex. 1016).
[11] US 6,856,690 B1, issued Feb. 15, 2005 (Ex. 1017).
[12] US 2006/0229014 A1, published Oct. 12, 2006 (Ex. 1098).
[13] US 7,069,452 B1, issued June 27, 2006 (Ex. 1019).
[14] US 5,761,298, issued June 2, 1998 (Ex. 1033).
[15] WO 2006/098584 A1, published Sept. 21, 2006 (Ex. 1099).

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–3, 6, 8, 10–13, 16, 18, 38–43, 46, 48, 51, 52, 54, 56	103(a)	Schrager,[16] Goldstein[17]
4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28, 44, 45, 47, 49, 50	103(a)	Schrager, Goldstein, Harada
29–31, 34, 36, 51, 53, 55	103(a)	Schrager, Goldstein, Davis
32, 33, 35, 37	103(a)	Schrager, Goldstein, Davis, Harada
20–22, 25, 27, 39, 54–56	103(a)	Schrager, Goldstein, Skulley
23, 24, 26, 28	103(a)	Schrager, Goldstein, Skulley, Harada

Dec. Inst. 53; Pet. 2.

II. ANALYSIS

A. Legal Standards

To prevail in its challenge, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). "In an IPR, the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (2012) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). This burden of persuasion never shifts to the patent owner. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

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[16] US 7,072,686 B1, issued July 4, 2006 (Ex. 1101).
[17] US 2008/0031475 A1, published Feb. 7, 2008 (Ex. 1026).

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective indicia of non-obviousness (also called secondary considerations), such as commercial success, long-felt but unsolved needs, and failure of others. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We analyze grounds based on obviousness in accordance with the above-stated principles.

B. Level of Ordinary Skill in the Art

In determining whether an invention would have been obvious at the time it was made, 35 U.S.C. § 103 requires us to resolve the level of ordinary skill in the pertinent art at the time of the invention. *Graham*, 383 U.S. at 17. The person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the invention. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). Factors that may be considered in determining the level of ordinary skill in the art include, but are not limited to, the types of problems encountered in the art, the sophistication of the technology, and educational level of active workers in the field. *Id.* In a given case, one or more factors may predominate. *Id.*

Petitioner contends that a person having ordinary skill in the art "would have had background in wireless networks, including at least a bachelor's degree in electrical engineering or a related field and experience

with wireless networks, and would have worked on a team including members with headphone-design experience." Pet. 7 (citing Ex. 1003 ¶¶ 30–37; Ex. 1005 ¶¶ 41–45).

Patent Owner contends a person having ordinary skill in the art ("POSA") "would be someone working in the electrical engineering field and specializing in or knowledgeable of speaker components for small wireless devices," and "would have a bachelor's degree in electrical engineering and at least two years of work experience in the industry." PO Resp. 6 (citing Ex. 2047 ¶ 19). Patent Owner adds that a POSA would thus "have studied and have practical experience with circuit design, speaker components, and wireless communication." *Id.* (citing Ex. 2047 ¶ 19).

Patent Owner argues that its proposed skill level is more appropriate because the '025 patent relates to headphones, which Petitioner's expert acknowledges, and Patent Owner's proposed POSA specializes in, or has knowledge of, speaker components for small wireless devices, but Petitioner's proposed POSA lacks such skill or knowledge. *Id.* at 6–7.

In the Decision on Institution, we adopted Petitioner's proposed level of ordinary skill in the art, stating it was "consistent with the evidence of record, including the asserted prior art." Dec. Inst. 10. Patent Owner concedes that its proposal is only "a slightly different skill level." PO Resp. 6. We agree that the two proposals do not differ materially. Regarding Patent Owner's argument that Petitioner's proposed POSA lacks knowledge of speaker components for small wireless devices, we note that under Petitioner's proposal, the POSA "would have worked on a team including members with headphone-design experience." Pet. 7. By working on such a team, Petitioner's proposed POSA would have gained, or at least had access to, knowledge of speaker components for small wireless devices.

As such, Petitioner's proposed definition implicitly includes what Patent Owner's proposal purports to add.

Furthermore, during the oral hearing, Patent Owner indicated that "the Board should adopt the POSA's skill level set forth in the Petition" and the level of skill adopted in the Decision on Institution "is warranted in this case." Tr. 48:21–22, 50:3–4.

Based on our review of the record before us, we find that Petitioner's stated level of ordinary skill in the art is reasonable because it is consistent with the evidence of record, including the asserted prior art. Accordingly, for the purposes of this Decision, we apply Petitioner's definition, although our conclusions would be the same if we were to apply Patent Owner's definition.

C. Dr. Williams' Credibility

Patent Owner argues that the testimony of Dr. Williams, Petitioner's declarant, "should be afforded little if any weight for three reasons." PO Resp. 61. First, "the opinions expressed in his declaration (BOSE-1003) are founded on a POSA skill level that he, in fact, did not use, thereby rendering his opinions valueless." *Id.* According to Patent Owner, during cross-examination, Dr. Williams "recant[ed] . . . his original POSA skill level" and "instead applied a POSA skill level where a POSA 'is a team of people who have experience in wireless networking and people who have experience in headset design.'" *Id.* at 60–61 (quoting Ex. 2023, 30).

Patent Owner advances two other arguments that hinge on the first argument: 1) "because Williams said a POSA is a team [during his cross-examination], his opinions are contrary to the law"; and 2) "at bottom, his conflicting POSA standards make his testimony unreliable. It is unclear what skill level Williams applied for a POSA in his obviousness opinions."

PO Resp. 61–62. Patent Owner advances similar arguments in its Sur-reply. *See* Sur-reply 2 ("Simply put, Williams did not perform the analysis that he swore to in his original declaration, which undercuts his overall credibility.").

Dr. Williams relies on the testimony of Dr. Casali (Petitioner's other declarant), "concerning the relevant headphone design features in much the same way that a POSA (*i.e.*, an individual with expertise in wireless networking as described above) would have worked with an individual with specific experience in headphone design when designing a wireless headphone product." Ex. 1003 ¶ 36. Patent Owner agrees that Dr. Williams does not advance that a POSA is a team in his original declaration. *See* PO Resp. 60–62. Rather, Dr. Williams applies the concept of a team *member* having gained the requisite knowledge of speakers for small wireless devices through other team members, such as Dr. Casali. *See* Ex. 1003 ¶ 36. In other words, in preparation for this trial, Dr. Williams studied the declaration of Dr. Casali, and other evidence, including the prior art of record. *See id.* ¶¶ 15, 36. Patent Owner does not dispute that Dr. Williams at least has the requisite level of ordinary skill to testify in this proceeding. *See* PO Resp. 60–62.

Moreover, Dr. Williams applies the level of ordinary skill as he states in his declaration, and this does not conflict with his deposition. *See* Ex. 1003 ¶ 36 ("A POSA would have been capable of understanding and applying the teachings of the '025 patent and the prior art references discussed in this declaration."). Contrary to Patent Owner's argument, Dr. Williams did not indicate on cited page 30 of his deposition that he "recant[ed] . . . his original POSA skill level." *See* PO Resp. 60–61 (citing Ex. 2023, 30). Rather, he testifies that he "would be *one of the members* of

the team of that POSA team." *See* Ex. 2023, 30:12–13 (emphasis added). During his deposition, Dr. Williams confirmed his

> opinion that, as I express in the bottom part of . . . paragraph [35 of my original declaration], in this case, a POSA would have worked on a team with someone knowledgeable with headphone form factors. *But that does not change the definition of a POSA as an individual with wireless networking experience because the art to which the purported technical advance of the '934 patent principally relates is wireless networking*.[18]

Ex. 2023, 35:13–21 (emphasis added); *accord* Pet. Reply 33 (quoting part of the same passage (citing Ex. 2023, 35–36)).

As discussed above, and as Dr. William's testimony shows, each member of the team at least would have gained "some knowledge of speaker components for small wireless devices" (as Patent Owner proposes) by working on that team or otherwise through other experience. As also noted, Dr. Williams relies on Dr. Casali's testimony and the record evidence here to gain the required headphone knowledge. *See* Ex. 1003 ¶ 15 (listing the record evidence as materials he "studied and considered," including Dr. Casali's declaration (Ex. 1005)), ¶¶ 35–37 (equating his reliance on Dr. Casali's declaration as a team member through which Dr. Williams testifies he "assumed the perspective of a person having ordinary skill in the art" to form his opinion). This required knowledge (in addition to knowledge of wireless networks), only requires some rudimentary knowledge about well-known form factors, given the breadth of the claims at issue here. As Dr. Williams testifies, "the art to which the purported

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[18] "[T]he '943 patent" likely refers to U.S. Patent No. 10,469,934 B2, which was challenged in related proceeding IPR2021-00680.

technical advance of the ’934 patent principally relates is wireless networking.” Ex. 2023, 35:19–21.

Moreover, Mr. McAlexander, Patent Owner’s declarant, similarly lacks direct experience in headphone design. And Mr. McAlexander and Dr. Williams each worked in cell phone design, which includes small speakers. *Compare* Ex. 1003 ¶ 3 (testifying “I have also designed cellular chipsets for operation in cellular phones” and “I have over 40 years of professional experience in wireless communications and telecom technology”), *with* Ex. 2024 ¶ 8 (testifying that he “investigated processes and designs associated with . . . telephones”). Mr. McAlexander also testifies that an artisan of ordinary skill “would be someone working in the electrical engineering field and specializing in or knowledgeable of speaker components for small wireless devices.” *Id.* ¶ 19. But Mr. McAlexander does not testify that this knowledge must be direct knowledge, and he does not testify that he worked directly with small speakers. Rather, he generally testifies that he “investigated processes and designs associated with . . . telephones”: “I have investigated processes and designs associated with personal computers, peripheral computers, software, and wireless communications systems, including telephones, microprocessors, controllers, memories, programmable logic devices, and other consumer electronics.” *Id.* ¶ 8, *see also id.* ¶¶ 1–7, 9 (testifying “I am very familiar with how acoustic speakers operate and the design issues associated with sound systems” without mentioning the size of the speakers.). During his deposition, Mr. McAlexander agreed that he “had not ever designed a headphone” and that “outside of litigation counseling,” he had “not worked on any specific projects that are related to the headphone.” Ex. 1141, 7:13–23.

Nevertheless, Mr. McAlexander testifies that “I satisfied this skill level circa 2008–2009 (and satisfy it now); and I am familiar with the knowledge and skills that a person with this skill level would have possessed circa 2008–2009 through my work and interaction with colleagues in the field.” Ex. 2024 ¶ 19.

On this record, we are not persuaded that there is any reason to discount the weight associated with Dr. William’s testimony.

D. Claim Construction

“In an *inter partes* review proceeding, a claim of a patent . . . shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. § 42.100(b) (2020). Under that standard, we generally give claim terms their ordinary and customary meaning, as would be understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1313–14 (Fed. Cir. 2005) (en banc). Although extrinsic evidence, when available, may also be useful when construing claim terms under this standard, extrinsic evidence should be considered in the context of the intrinsic evidence. *Id.* at 1317–19.

Petitioner asserts that because “the prior art plainly discloses claim elements, express construction is unnecessary.” Pet. 8 (citing *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017)).

Patent Owner does not discuss claim construction in a separate claim construction section of its Response, but in addressing one of the asserted grounds, Patent Owner argues that the term “body portion” of claim 40 should be construed as “the central or main portion of the earphone.” PO

Resp. 43 (citing Ex. 2024 ¶ 60). Relying on a dictionary definition, Patent Owner argues that "[t]he ordinary meaning of 'body' in this context is 'the main, central, or principal part.'" *Id.* (citing Ex. 2024 ¶ 60; Ex. 2041, 4). Patent Owner contends that this meaning is consistent with the '025 patent because disclosed "body 12" forms the main, central, or principal part of earphone 10. *Id.* (citing Ex. 2024 ¶ 60; Ex. 1001, 3:15–20, Figs. 1A–1B).

Petitioner argues that Patent Owner improperly conflates "body" with "body portion," and the plain meaning of "body portion" is "a part of a 'body.'" Pet. Reply 21. In its Sur-reply, Patent Owner reiterates its proposed construction and quotes *Fisher-Price, Inc. v. Evenflo Co.*, Case No. 05-cv-280S, 2006 WL 1740263, *3 (WDNY June 26, 2006) as stating: "When the term 'body' is used in connection with an intimate object, its ordinary meaning is . . . the main, central or principal part of something." PO Sur-reply 15. Patent Owner asserts that:

> No reasonable person would consider the tail (or empennage) of an airplane to be the "body portion" of the airplane, even though it is part of the airplane, because the tail is not the main, central, or principal part of the airplane; the fuselage is the main part. Similarly, the "body portion" of the earphone is the main or central part of the earphone.

Id.

In light of the disclosure in the Specification, Patent Owner's arguments are not persuasive. The Court of Appeals for the Federal Circuit has stated:

> The main problem with elevating the dictionary to such prominence is that it focuses the inquiry on the abstract meaning of words rather than on the meaning of claim terms within the context of the patent. Properly viewed, the "ordinary meaning" of a claim term is its meaning to the ordinary artisan after reading the entire patent. Yet heavy reliance on the dictionary divorced

> from the intrinsic evidence risks transforming the meaning of the claim term to the artisan into the meaning of the term in the abstract, out of its particular context, which is the specification.

Phillips, 415 F.3d at 1321. In this case, the intrinsic evidence does not comport with Patent Owner's proffered dictionary definition, which is just one of several definitions of "body" provided by the cited dictionary.[19] Specifically, the '025 patent describes various embodiments of wireless earphones, including those depicted in Figures 1A and 1B, which are reproduced below.

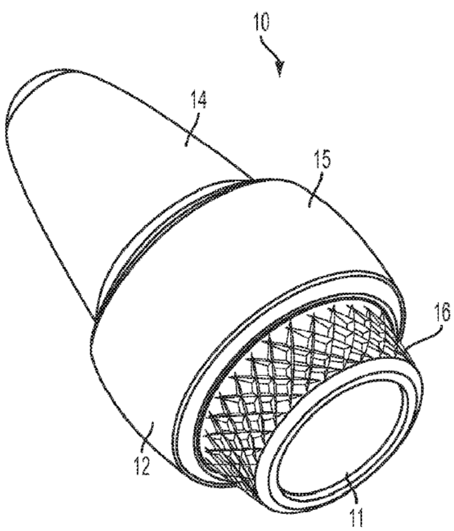

FIG. 1A

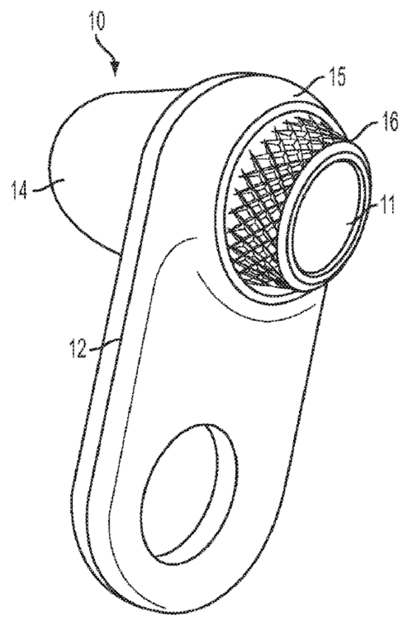

FIG. 1B

Figures 1A and 1B show example configurations of wireless earphone 10. Ex. 1001, 3:11–12. In each configuration, earphone 10 comprises body 12. *Id.* at 3:15–16. Body 12 comprises ear canal portion 14 that is inserted into a user's ear canal and exterior portion 15 that is not inserted into the ear canal.

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[19] The district court's use of the same dictionary definition of "body" to construed the term "body portion" in *Fisher-Price* is not applicable here because that case involved a different patent relating to an invention in a different field of art.

Id. at 3:16–20. Exterior portion 15 further includes knob 16 with button 11. *Id.* at 3:20–21, 8:27–30.

Accordingly, we disagree with Patent Owner's assertion that body 12 forms the main, central, or principal *part* of earphone 10 (*see* PO Resp. 43) because it comprises both ear canal portion 14 and exterior portion 15, which make up the entirety of earphone 10. Furthermore, we agree with Petitioner that Patent Owner improperly conflates "body" with "body portion" by relying on a dictionary definition for "body" as defining "body portion." Patent Owner's reliance on the definition of "body" as defining "body portion" arguably requires body 12 to correspond to the claimed "body portion."[20] But body 12, which comprises both ear canal portion 14 and exterior portion 15, cannot correspond to the claimed "body portion" because claim 40 also recites a separate "elongated portion."

Moreover, Patent Owner submits an annotated version of Figure 1B of the '025 patent, which we reproduce below, that identifies a "body portion" that does not correspond to body 12 as a whole.

[20] Other arguments by Patent Owner also appear to suggest that body 12 corresponds to the claimed "body portion." *See* PO Sur-reply 16 ("Patent Owner's interpretation of 'body portion' also comports with the 'body 12' in Figure 1B of the '025 Patent."), 17 (referring to "body portion 12").

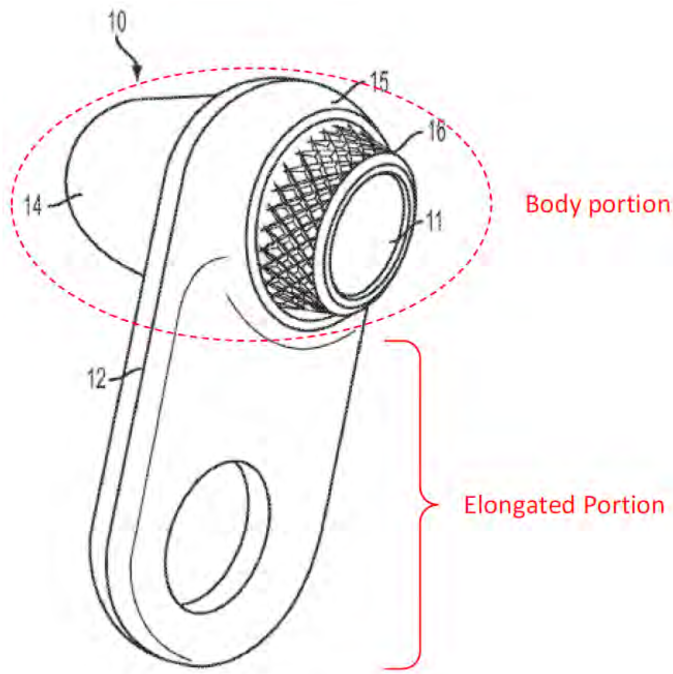

FIG. 1B

PO Sur-reply 17. For this annotated version of Figure 1B, Patent Owner adds (1) a dashed oval enclosing ear canal portion 14 and an upper portion of exterior portion 15 that is labelled "Body portion," and (2) a bracket adjacent to a lower portion of exterior portion 15 that is labelled "Elongated Portion." *Id.* Because this annotated figure depicts the "body portion" as something less than the entire body 12, it contradicts Patent Owner assertion that the dictionary definition of "body" should define the "body portion."

For the above reasons, we decline to adopt Patent Owner's proposed construction of "body portion" as insufficiently supported by the intrinsic evidence.

Focusing on the intrinsic evidence, we note that claim 40 recites that each earphone comprises "a body portion that sits at least partially in an ear" and "an elongated portion that extends from the body portion." In other words, each earphone comprises two distinct "portions." The written description of the '025 patent does not use the term "body portion" or

"elongated portion" and, thus, does not provide much guidance on construing the claim terms.[21] Accordingly, because claim 40 requires that the "body portion" and "elongated portion" are two distinct portions of each earphone, we construe "body portion" as "a portion or section of the earphone that forms a body."

We determine that we need not expressly construe any other claim term to resolve the parties' disputes because doing so would have no effect on the analysis below. *See Nidec*, 868 F.3d at 1017; *see also Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms that . . . are in controversy, and only to the extent necessary to resolve the controversy.'") (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

E. Ground 1A: Asserted Obviousness Based on Rezvani-446, Rezvani-875, and Skulley

Petitioner asserts that claims 1–3, 6, 8, 11–13, 16, 18, 20–22, 25, 27, 39, 52, and 54–56 are unpatentable under 35 U.S.C. § 103(a) based on Rezvani-446, Rezvani-875, and Skulley. Pet. 10–33. Patent Owner provides arguments addressing this asserted ground of unpatentability. PO Resp. 12–20. We first summarize the references and then address the parties' contentions.

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[21] As discussed above, the '025 patent describes earphone 10 as comprising ear canal portion 14 that is inserted into a user's ear canal and exterior portion 15 that is not inserted into the ear canal. Ex. 1001, 3:15–20. Thus, it is reasonable to correlate ear canal portion 14 to the claimed "body portion" and exterior portion 15 (at least the exterior portion depicted in Figure 1B) to the claimed "elongated portion."

1. Rezvani-446

Rezvani-446 relates to providing content wireless portable media ("WPM") clients by creating a wireless link between the WPM clients and a WPM server. Ex. 1097 ¶ 4. In one embodiment, the system includes WPM server 402 and headset 404 as the sole WPM client. *Id.* ¶ 55, Fig. 4. A user of headset 404 may make a request for music files across a wireless link to WPM server 402. *Id.* ¶ 55. Figure 7 of Rezvani-446 is reproduced below.

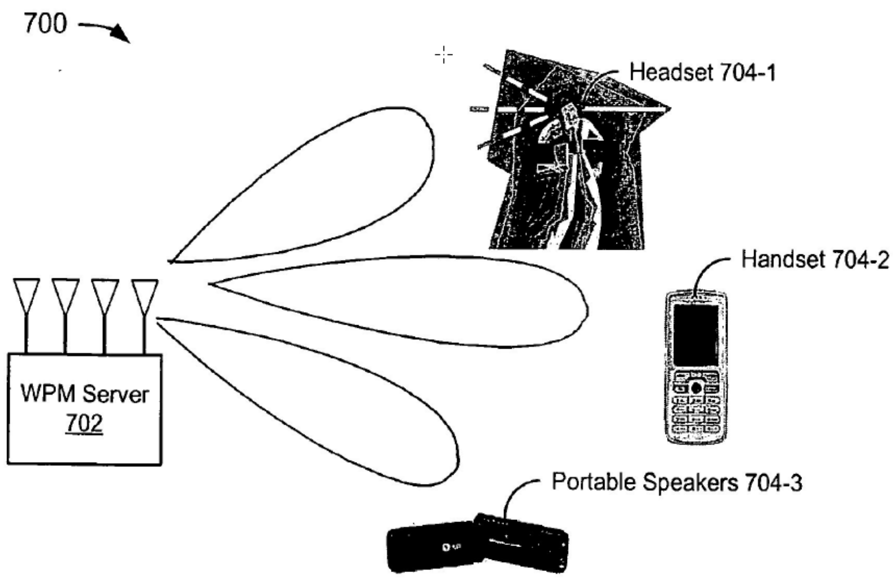

FIG. 7

Figure 7 illustrates a system that includes various WPM clients in a WPM environment. *Id.* ¶¶ 4, 69. More specifically, Figure 7 shows WPM server 702 in wireless communication with WPM clients, including headset 704-1, handset 704-2, and portable speakers 704-3. *Id.* ¶ 69.

2. Rezvani-875

Rezvani-875 discloses a "wireless multi-media headset with high fidelity sound" that performs a "seamless handoff between multiple wireless interfaces." Ex. 1016, code (57). The headset is capable of several applications and multiple wireless systems may be incorporated. *Id.* ¶ 19.

For example, support may be provided for various cellular standards, Wi-Fi standards, and the Bluetooth standard among others. *Id.* Figure 2 is reproduced below.

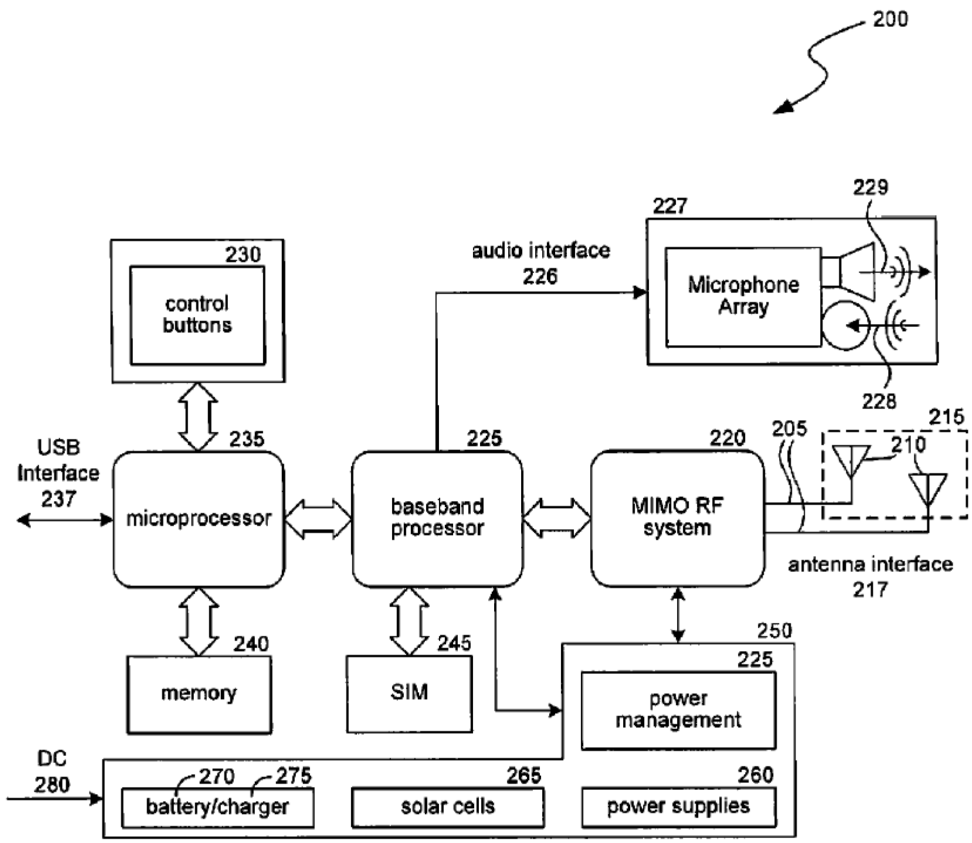

FIG. 2

Figure 2 depicts the subsystems that support the various functionalities. *Id.* ¶¶ 6, 20. These subsystems include antenna array 215, baseband processor 225, microphone array 227, and control buttons 230 for a user interface. *Id.* ¶ 20. Microprocessor 235 performs operations for the various functionalities with the assistance of internal memory 240. *Id.* Power subsystem 250 includes power supplies 260, solar cells 265, battery 270, and battery charger 275. *Id.* ¶ 21.

3. Skulley

Skulley discloses that headsets can incorporate one or two earphones and can be classified into three general types: (1) "in-the-ear" earphones, also referred to as "ear buds"; (2) "on-the-ear" earphones; and (3) "over-the-ear" earphones. Ex. 1017, 1:21–34.

4. Independent Claim 1

Petitioner contends that the proposed combination of Rezvani-446, Rezvani-875, and Skulley discloses the limitations of claim 1. Pet. 15–28. Patent Owner argues that Rezvani-875 teaches away from the proposed combination and Figure 2 of Rezvani-875 does not depict a headset. PO Resp. 12–20. Patent Owner also argues that objective indicia of non-obviousness confirm that claim 1 would not have been obvious. *Id.* at 23–32.

a) The Combination of Rezvani-446, Rezvani-875, and Skulley

Petitioner first argues that one of ordinary skill in the art would have implemented Rezvani-446's system using Rezvani-875's headset. Pet. 13. According to Petitioner, one reason for this modification is that Rezvani-875's disclosure of its headset being wirelessly connected to another device such as a music server "would have suggested using Rezvani-875's headset in Rezvani-446's system because Rezvani-446's system supports a wireless headset 'capable of receiving and using content from' a WPM server storing music." *Id.* (citing Ex. 1016 ¶ 33; Ex. 1097 ¶¶ 22, 55, Fig. 4; Ex. 1003 ¶¶ 99–100). Petitioner also argues that this modification "would have been 'nothing more than the predictable application of known technology,'" because "an intended use for Rezvani-875's headset is connecting to a music server like Rezvani-446's WPM

server." *Id.* at 13–14 (quoting *B/E Aerospace v. C&D Zodiac*, 962 F.3d 1373, 1379 (Fed. Cir. 2020); citing Ex. 1016 ¶ 33; Ex. 1003 ¶ 101).

Next, Petitioner argues that one of ordinary skill in the art would have implemented Rezvani-875's headset with two earphones in Rezvani-446's system. *Id.* at 14. Petitioner presents three reasons for this modification. First, Petitioner argues that Rezvani-875's disclosure of playing music and offering high fidelity sounds would have motivated using two earphones. *Id.* (citing Ex. 1016 ¶¶ 4, 15–17, code (57); Ex. 1005 ¶¶ 47–48; *KSR*, 550 U.S. at 417–18). Second, Petitioner argues that Skulley teaches that two-earphone headphones were common, and implementing the headset with two earphones "would have been applying a known technique to improve similar devices in the same way (*e.g.*, to produce stereo sound)." *Id.* (citing Ex. 1005 ¶¶ 47–48, 136, 142–143; *KSR*, 550 U.S. at 417). Third, Petitioner argues that "two-earphone headphones would have been obvious to try because, per Skulley, that was one of two predictable configurations—one or two earphones." *Id.* (citing Ex. 1005 ¶¶ 47–48, 137; *KSR*, 550 U.S. at 421).

Petitioner also argues that one of ordinary skill in the art would have had a reasonable expectation of success because the proposed modifications would have been routine. *Id.* at 15 (citing Ex. 1005 ¶¶ 50–70, 138; Ex. 1003 ¶ 106).

Patent Owner argues that the headset of Petitioner's combination has two wireless links (one with Rezvani-446's WPM server and one with Rezvani-446's handset 704-2), but one of ordinary skill in the art "would have had no reason to tax Rezvani-875's headset with an additional connection to the WPM server" because Rezvani-875's headset is already in wireless communication with handset 704-2 for the same purpose of

obtaining music.[22] PO Resp. 13–14. Patent Owner contends that having two wireless connections instead of one would drain the headset's battery faster and one of ordinary skill in the art would not be interested in such a design. *Id.* at 14 (citing Ex. 2024 ¶ 42).

Patent Owner also argues that ¶ 39 of Rezvani-875 discloses "maintaining a headset in a 'low power' mode 'by shutting down all functions not associated with maintaining a low-rate wireless connection to the handset,'" and that disclosure "cuts against Petitioner's rationale" for combining the references. *Id.* Patent Owner asserts that "[m]odifying Rezvani-875's headset with an additional connection in spite of Rezvani-875's clear purpose of operating in low power by shutting down all functions not associated with maintaining a low-rate wireless connection to the handset, clearly extends beyond the simple swapping of headsets." *Id.* at 14–15 (citing Ex. 2024 ¶ 43).

In its Reply, Petitioner argues that Patent Owner's battery drain argument overlooks that Rezvani-875 repeatedly explains "that its headset 'supports simultaneous operation' over multiple wireless interfaces," including a connection to a music server. Pet. Reply 3. (citing Ex. 1016 ¶¶ 33, 40, 49, Fig. 8, claims 1–7, 28–35). According to Petitioner, "[f]ar from being a 'tax' on Rezvani-875's headset, simultaneous wireless connections, including to a music server, are its raison d'être." *Id.*

We agree with Petitioner that Rezvani-875 discloses simultaneous operation of its headset over multiple wireless interfaces. *See, e.g.*, Ex. 1016 ¶¶ 40, 41, 49. Indeed, Patent Owner concedes in its Sur-reply that

[22] Patent Owner also asserts that ¶ 33 of Rezvani-875 "cuts against Petitioner's rationale" for combining the references, but does not discuss any specific language of ¶ 33. PO Resp. 13.

"Rezvani-875's headset supports simultaneous operation over multiple wireless interfaces, such that it could be used in Rezvani-446's system." PO Sur-reply 5. As such, Rezvani-875 would not have suggested to one of ordinary skill in the art that providing a headset with multiple wireless connections would produce undesirable battery drain. Accordingly, we are not persuaded that one of ordinary skill in the art would have been dissuaded from using two wireless connections because of increased battery usage.

Regarding Patent Owner's argument that ¶ 39 of Rezvani-875 teaches away from the proposed combination, Petitioner asserts that the "low power mode" described in this paragraph does not nullify Rezvani-875's support for multiple wireless connections. Pet. Reply 4. Specifically, Petitioner asserts that Rezvani-875's claims explicitly recite both low power operation and multiple wireless connections. *Id.* (citing Ex. 1016, claims 28, 32–35, 50).

We agree with Petitioner that the claims of Revani-875 show that the reference contemplates supporting multiple wireless connections during the low power mode. For example, Revani-875's claim 28 recites a multimedia headset that includes "power management means for ultra low power operation," and claim 32, which indirectly depends from claim 28, recites "means supporting simultaneous operation over two or more different wireless systems." Ex. 1016, claims 28, 32.

Furthermore, paragraph 39 states that "[t]he headset may be designed such that a certain application or set of applications that require relatively low power can be maintained for an indefinite time period under solar power alone," by using "aggressive power management [to] allow the device to support the given application(s) indefinitely without recharging by shutting down all nonessential functions except those associated with the specific

application or applications." Ex. 1016 ¶ 39. As such, Rezvani-875 discloses shutting down nonessential functions only when operating under solar power alone. Rezvani-875's device, however, includes not only solar cells 265, but also power supplies 260 and battery 270 for powering the device. *Id.* ¶ 21, Fig. 2. Accordingly, operating under solar power alone is an alternative power mode applicable to maintaining "a certain application or set of applications that require relatively low power." *Id.* ¶ 39. Patent Owner does not contend that Rezvani-875 teaches away from maintaining multiple wireless connections when using one or more of the other power sources. For these reasons, we determine that ¶ 39 does not teach away from the proposed combination. *See DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1327 (Fed. Cir. 2009) (holding a reference does not teach away "if it merely expresses a general preference for an alternative invention but does not 'criticize, discredit, or otherwise discourage' investigation into the invention claimed").

In addition, Patent Owner argues that Rezvani-875's disclosure of simultaneous operation over multiple wireless interfaces "at best suggests that Rezvani-875's headset could connect to a music server, like Rezvani-446's WPM server, and to an ***arbitrary*** handset." PO Sur-reply 5–6. Patent Owner contends that "[t]here is no suggestion that Rezvani-875's headset, once swapped into Rezvani-446's system, would also have a connection to the very same handset that also has a connection with Rezvani-446's WPM server." *Id.* at 6. Patent Owner argues that it would not have been obvious to connect Rezvani-875's headset to Rezvani-446's handset because Rezvani-875's headset already is connected to the server for the same purpose of accessing music files, and poses the question: "Why would Rezvani-875's headset need to connect to a handset that has a

wireless connection to a server to which Rezvani-875's headset is already connected?" *Id.* at 6–7.

Petitioner, however, argues that Rezvani-875 expressly discloses its headset getting music from multiple sources. Pet. Reply 3 (citing Ex. 1016 ¶ 33). Relying on the testimony of Dr. Williams, Petitioner also argues that the headset being capable of connecting to a server and a handset would provide music-source flexibility desired by users. *Id.* (citing 1003 ¶¶ 42, 115–116; Ex. 1141, 76–79); *see also* Tr. 8:10–25 (arguing that Dr. Williams explained the benefits of music-source flexibility).

Dr. Williams testifies that "[s]treaming music from the server and storing music for later playback on a DAP (*e.g.*, a cellular phone or MP3 player) would have provided a headset's end-user with desirable flexibility in the available sources for digital audio content." Ex. 1003 ¶ 116. As an example of why such flexibility would have been desirable, Dr. Williams testifies that the dual arrangement would enable the user "to listen to music from their phone or MP3 player even if the connection to the server were poor and/or the server was unavailable." *Id.* (citing Ex. 1128 ¶¶ 19–20, 26, 57–58; Ex. 1131 ¶¶ 5, 167; Ex. 1134, 1:24–37; Ex. 1111 ¶ 37; Ex. 1110 ¶¶ 2–4). We credit Dr. Williams' uncontroverted testimony on this point, which we find persuasive and supported by evidence.

Moreover, Rezvani-875 discloses that the headset may obtain music files from a variety of sources, such as "a wireless connection to the Internet, via a cellular telephone connection, . . . or via a wired or wireless connection to another device (e.g. a wireless connection to a computer, music server, handset, PDA, or other wireless device)." Ex. 1016 ¶ 33. We find that this disclosure, together with Rezvani-875's disclosure of simultaneous operation over multiple wireless interfaces (*see id.* ¶¶ 40, 41, 49) and

Dr. Williams' testimony, would have suggested to one of ordinary skill in the art providing wireless connections between Rezvani-875's headset and both WPM server 702 and handset 704-2.

In sum, we determine that Petitioner's proposed reasons to combine Rezvani-446, Rezvani-875, and Skulley are realistic, have rational underpinning, and are supported by expert testimony, which we find persuasive and credit. Thus, Petitioner's evidence shows that a skilled artisan would have had reasons to combine the teachings of Rezvani-446, Rezvani-875, and Skulley and would have had a reasonable expectation of success in doing so.

b) The Limitations of Claim 1

Petitioner contends that Rezvani-446 discloses a headphone assembly generally (i.e., headset 704-1) and Rezvani-875 discloses a headphone assembly having the claimed antenna, wireless communication circuit, processor, rechargeable battery, and microphone (i.e., the headset depicted in Figure 2). Pet. 10–12, 18–25. Petitioner argues that the combination of Rezvani-446, Rezvani-875, and Skulley uses a two-earphone headset, with each earphone having an acoustic transducer. *Id.* at 20 (citing 1003 ¶ 121; Ex. 1005 ¶¶ 128–129). Petitioner also contends that WPM server 702 of Rezvani-446 corresponds to the claimed remote, network-connected server. *Id.* at 10–11, 25–26.

Regarding the claimed mobile, digital audio player with which the headphone assembly is in wireless communication, Petitioner contends that Rezvani-446 discloses using mobile wireless handset 704-2 with WPM server 702. *Id.* at 10, 16 (citing Ex. 1097 ¶¶ 22, 42, 46, 55, 69, Figs. 4, 5, 7). Petitioner also contends that Rezvani-875 teaches that wireless headphones were commonly used with cell phones for hands-free operation and cell

phones commonly stored and played back music by 2008. *Id.* at 16–17 (citing Ex. 1016 ¶ 4, Fig. 9; Ex. 1003 ¶¶ 111–116). In addition, Petitioner contends that Rezvani-446 teaches that the "WPM clients 'include ***any device*** capable of receiving and using content' from the WPM server . . . , and mobile MP3 players with wireless-communication functionality were common by April 2008." *Id.* at 17 (quoting Ex. 1097 ¶ 22; citing Ex. 1097 ¶ 42; Ex. 1003 ¶¶ 113–114; Ex. 1099 ¶¶ 3–5; Ex. 1126 ¶¶ 18–19, 22, 25).

Based on these contentions, Petitioner argues that it would have been obvious to one of ordinary skill in the art at the time of invention to implement the combination of Rezvani-446, Rezvani-875, and Skulley with a handset or MP3 player capable of storing digital audio content "because Rezvani-446 teaches that music from the WPM server is either streamed to WPM clients or ***downloaded to those clients for later playback***." *Id.* (citing Ex. 1097 ¶ 73). As for the requirement in claim 1 that the headphone assembly be in wireless communication with the digital audio player, Petitioner contends that the combination of Rezvani-446, Rezvani-875, and Skulley would include this feature because Rezvani-875 teaches that mobile digital audio players and headsets communicate via conventional wireless connections. *Id.* at 19 (citing Ex. 1016 ¶¶ 4, 33, 39, 42, Fig. 9; Ex. 1003 ¶ 118).

Petitioner also argues that the combination's digital audio player uses a Bluetooth connection (i.e., an ad hoc wireless communication link) to transmit digital audio content that is played back through the headset's earphones. *Id.* at 19 (citing Ex. 1016 ¶ 4; Ex. 1097 ¶¶ 42–43, 58–59, 73; Ex. 1003 ¶ 132; Ex. 1005 ¶¶ 128–129). Last, Petitioner argues that the combination includes Rezvani-875's control buttons that initiate a search request for a song of other commands such as rewind or fast-forward. *Id.*

at 27 (citing Ex. 1016 ¶¶ 35–36, claims 14, 41; Ex. 1097 ¶¶ 45–48, 59; Ex. 1003 ¶ 133; Ex. 1005 ¶ 139). According to Petitioner, these searches and commands 'initiat[e] transmission of a request' to the server, as claimed" and are implemented by the microprocessor. *Id.* at 27–28 (citing Ex. 1016 ¶ 20; Ex. 1003 ¶¶ 133–136).

Patent Owner argues that, although relying on Rezvani-875's Figure 2 as disclosing the claimed headphone assembly components, Petitioner fails to prove that Figure 2 depicts a headset and, thus, fails to show that the combination possesses the claimed headphone assembly components. PO Resp. 16 (citing Pet. 18–25; Ex. 1003 ¶¶ 117–130), 20. Patent Owner points to the following three reasons as showing that one of ordinary skill in the art would not have understood that Rezvani-875's Figure 2 depicts a headset.

First, Patent Owner contends that Rezvani-875 never states that Figure 2 shows a headset. *Id.* at 16. Specifically, Patent Owner argues that Rezvani-875 does not identify Figure 2 as showing a headset in either the Brief Description of the Drawings section or the description of Figure 2 in contrast to explicitly referring to Figure 1 as showing a headset. *Id.* at 16–17 (citing Ex. 1016 ¶¶ 5–6, 18, 20; Ex. 2024 ¶ 36).

Second, Patent Owner argues that Rezvani-875's use of different reference numerals in Figures 1 and 2 implies that the device depicted in Figure 2 is not a headset. *Id.* at 17 (citing Ex. 1016 ¶¶ 18, 20, Fig. 1; Ex. 2024 ¶ 37; 37 C.F.R. § 1.84(p)(4)).

Third, Patent Owner argues that "the subsystems and components depicted in Figure 2 are not consistent with a headset but in contrast are consistent with other types of electronic devices in the relevant time frame (circa 2008, the priority date for the '025 Patent), particularly a cell phone." *Id.* at 18. For example, Patent Owner argues that Figure 2 depicts a

Subscriber Identity Module ("SIM") card, which typically is installed in a cell phone. *Id.* (citing Ex. 1016 ¶ 21; Ex. 2024 ¶ 38; Ex. 2023, 56). According to Patent Owner, the presence of the SIM card "precludes Figure 2 from depicting a headset." *Id.* at 18–19 (citing Ex. 2024 ¶ 38). Patent Owner further argues that Rezvani-875's solar cells 265, DC input 280, and USB interface 237 are components not commonly included in wireless headsets circa 2008. *Id.* at 19 (citing Ex. 1016 ¶¶ 20–21; Ex. 2024 ¶ 39; Ex. 2023, 58).

Petitioner replies by arguing that Rezvani-875 expressly states that Figure 2 shows headset components. Pet. Reply 5, 7 (citing Ex. 1016 ¶¶ 38, 47). We agree with Petitioner. Paragraph 38 of Rezvani-875 states: "As shown in FIG. 2, *the headset* may have an optional power management algorithm . . . ." Ex. 1016 ¶ 38 (emphasis added). Paragraph 47 states: "As shown in FIG. 2, *the headset* has a power management algorithm . . . ." *Id.* ¶ 47 (emphasis added). Both of these statements indicate that Figure 2 shows a headset despite ¶ 21 of Rezvani-875 referring to Figure 2 as depicting a "device."[23] We are not persuaded by Patent Owner's argument that ¶ 38 "merely explains that the headset could include a 'power management algorithm' like the device depicted in Figure 2." PO Resp. 19 (citing Ex. 1016 ¶ 38; Ex. 2024 ¶ 40). Instead, we find that the above-quoted language from ¶ 38 and ¶ 47 (which Patent Owner does not address) clearly conveys that Figure 2 depicts a headset.

Regarding Patent Owner's second argument (i.e., Rezvani-875 uses different reference numerals in Figures 1 and 2), Petitioner argues that

[23] We note that ¶ 39 of Rezvani-875 appears to use the terms "headset" and "device" interchangeably.

"consistent with 37 C.F.R. § 1.84(p)(4), Figures 1 and 2 plainly depict different 'parts' of the headphone: a functional 'part' (Figure 1) and a hardware 'part' (Figure 2)." Pet. Reply 7 (citing Ex. 1016 ¶¶ 5–6, 19–21). Indeed, Figure 1 is a *functional* block diagram of the headset (Ex. 1016 ¶¶ 6, 18, Fig. 1), and Figure 2 illustrates the *subsystems* that support the various functionalities (*id.* ¶¶ 6, 20). In this sense, Figures 1 and 2 depict different aspects of the headset invention for which different reference numerals could be used. Thus, we are not persuaded that the use of distinct reference numerals indicates that Figure 2 does not depict a headset.

In reply to Patent Owner's third argument, Petitioner argues that "Rezvani-875's novelty was a headset with functionality conventionally associated with cellphones." Pet. Reply 7. Specifically, Petitioner argues that Figure 2 includes (1) a SIM card because the headset supports cellular phone standards; (2) a USB interface for loading music into the headset memory: and (3) solar cells and a DC input because the headset uses these power sources to charge the battery. *Id.* (citing Ex. 1016 ¶¶ 19, 21, 33, 39).

Rezvani-875 discloses that headset 100 may be integrated with various cellular phone standards 170. Ex. 1016 ¶ 19, Fig. 1. Rezvani-875 also discloses that the headset can have a cellular telephone connection. *Id.* ¶¶ 33, 40–41. In view of these disclosures, we disagree with Patent Owner's assertion that the presence of the SIM card precludes one of ordinary skill in the art from understanding that Figure 2 depicts a headset. *See* PO Resp. 18–19 (citing Ex. 2024 ¶ 38). As for USB interface 237 and solar cells 265, Rezvani-875 discloses that the "headset" may include "a USB high-speed data port" (Ex. 1016 ¶ 33) and may be designed to operate under solar power alone using embedded "solar cells" (*id.* ¶ 39), thereby undermining Patent Owner's and Mr. McAlexander's assertions that wireless headsets circa

2008 did not commonly include such elements. *See* PO Resp. 19; Ex. 2024 ¶ 39. Rezvani-875 does not appear to disclose a DC input beyond the description of Figure 2, but in disclosing that the "headset" can operate under solar power "without recharging," Rezvani-875 implies that the headset includes means for recharging. *See* Ex. 1016 ¶ 39.

For the above reasons, we are persuaded that one of ordinary skill in the art would have understood Figure 2 of Rezvani-875 to depict a headset and determine that Petitioner has met its burden of establishing that the combination of Rezvani-446, Rezvani-875, and Skulley discloses the headphone assembly limitations of claim 1.

Patent Owner does not offer any arguments specifically addressing the remaining limitations of claim 1. *See generally* PO Resp. We need not set forth formal findings as to the undisputed assertions by Petitioner that the combination of Rezvani-446, Rezvani-875, and Skulley discloses or suggests these limitations. *See LG Elecs., Inc. v. Conversant Wireless Licensing S.A.R.L.*, 759 F. App'x 917, 925 (Fed. Cir. 2019) ("The Board is 'not required to address undisputed matters' or arguments about limitations with which it was never presented." (quoting *In re Nuvasive, Inc.*, 841 F.3d 966, 974 (Fed. Cir. 2016))). Also, we cautioned Patent Owner "that any arguments not raised in the response may be deemed waived." Paper 16, 8; *cf.* 37 C.F.R. § 42.23(a) ("Any material fact not specifically denied may be considered admitted."). Nevertheless, we have reviewed Petitioner's contentions with respect to the remaining limitations of claim 1 and find that the combination of Rezvani-446, Rezvani-875, and Skulley discloses these limitations as set forth by Petitioner. *See* Pet. 15–18, 25–28.

c) Objective Indicia of Non-obviousness

(1) Legal Standard

We must consider any evidence of objective indicia of non-obviousness in the record before reaching our conclusion on obviousness. *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1328 (Fed. Cir. 2016). Factual inquiries for an obviousness determination include secondary considerations based on evaluation and crediting of objective evidence of non-obviousness. *Graham*, 383 U.S. at 17 (1966).

For objective indicia of non-obviousness to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention. *ClassCo, Inc., v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016). "[T]here is no nexus unless the evidence presented is 'reasonably commensurate with the scope of the claims.'" *Id.* (quoting *Rambus Inc. v. Rea*, 731 F.3d 1248, 1257 (Fed. Cir. 2013)). A patentee is entitled to a presumption of nexus "when the patentee shows that the asserted objective evidence is tied to a specific product and that product 'embodies the claimed features, and is coextensive with them.'" *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (quoting *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1072 (Fed. Cir. 2018)). "A finding that a presumption of nexus is inappropriate does not end the inquiry into secondary considerations"; rather, "the patent owner is still afforded an opportunity to prove nexus by showing that the evidence of secondary considerations is the 'direct result of the unique characteristics of the claimed invention.'" *Id.* at 1373–74 (quoting *In re Huang*, 100 F.3d 125, 140 (Fed. Cir. 1996)); *see also Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 33 at 33 (PTAB Jan. 24, 2020) (precedential) (explaining that

the Board uses a two-step analysis in evaluating nexus between the claimed invention and objective evidence).

"[T]he purpose of the coextensiveness requirement is to ensure that nexus is only presumed when the product tied to the evidence of secondary considerations is the invention disclosed and claimed." *Lectrosonics*, Paper 33 at 32 (citing *Fox Factory*, 944 F.3d at 1374) (emphasis and internal quotation marks omitted) (alteration in original). Also, "[a] patent claim is not coextensive with a product that includes a 'critical' unclaimed feature that is claimed by a different patent and that materially impacts the product's functionality." *Id.* (citing *Fox Factory*, 944 F.3d at 1375).

Ultimately, "[t]he patentee bears the burden of showing that a nexus exists." *WMS Gaming, Inc. v. Int'l Game Tech.*, 184 F.3d 1339, 1359 (Fed. Cir. 1999).

(2) Analysis

Patent Owner argues that the alleged commercial success of third-party products shows that claim 1, as well as dependent claims 2–10, 40–52, and 54, would not have been obvious. PO Resp. 23–32, 58–59. In particular, Patent Owner contends that Apple "sells consumer TWS[24] earbuds—the AirPods and AirPod Pros (collectively, 'AirPods Products')—that have achieved significant sales since they were introduced in late 2016, more than seven years after the latest possible priority date for the '025 Patent." *Id.* at 23. Patent Owner also argues there is "a strong nexus between claim 1 and the commercially successful AirPods Products." *Id.*

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[24] Patent Owner uses the term "TWS" to refer to "True Wireless" earphones; i.e., "[w]ireless earphones that do not have a wire/cord connected to the audio source and that do not have a band or wire/cord connected between the earphones." PO Resp. 4.

As evidence of commercial success, Patent Owner relies on public sources that estimate Apple sold 15 million AirPods in 2017, 35 million AirPods in 2018, 60 million AirPods in 2019, and 114 million AirPods in 2020. *Id.* at 24 (citing Ex. 2030, 15). Patent Owner asserts that "[e]stimated sales for the AirPods alone from 2017–2020 are 224 million units," and "[a]t $159 USD apiece, that amounts to more than $35 billion in sales in four years." *Id.* at 27 (citing Ex. 2030, 15). In addition, Patent Owner argues that the AirPods Products constituted almost 50% of the over 300 million TWS headsets shipped in 2020 and enjoyed significant sales in a growing market, "which is an 'important component of the commercial success inquiry.'" *Id*. (citing Ex. 2036, 2; quoting *In re Applied Materials, Inc*., 692 F.3d 1289, 1300 (Fed. Cir. 2012)).

In arguing that nexus should be presumed, Patent Owner primarily relies on a November 6, 2020, infringement claim chart, comparing the AirPods Products to the '025 patent's claims, that it had submitted in the Apple Litigation. *Id.* at 24–25 (citing Ex. 2037, 8–18, 68–78). In particular, Patent Owner asserts that the AirPods Products are the "headphone assembly" of claim 1 because they comprise two earphones, an antenna, a wireless communication circuit, a processor, a rechargeable battery, and a microphone. *Id.* at 27–28 (citing Ex. 2037, 8–18, 68–78; Ex. 2027, 2; Ex. 2028, 2; Ex. 2029, 6). Regarding the non-headphone limitations of claim 1, Patent Owner asserts that "the AirPods Products integrate into the Apple ecosystem by pairing with a mobile DAP (e.g., an iPhone); and initiate transmission of request to a remote, network-connected server (e.g., an Apple server that provides voice assistant (e.g., Siri) services)." *Id.* at 25 (citing Ex. 2037, 8–18, 68–78); *see also id.* at 28–29 (arguing that the AirPods Products are designed specifically to work in "the Apple

ecosystem") (citing 2039, 1; Ex. 2027, 2; Ex. 2028, 4; Ex. 2027, 2; Ex. 2029, 6).

Petitioner argues that Patent Owner has failed to meet its burden to establish nexus, because the AirPods Products do not embody claim 1, and because Patent Owner has not shown the required coextensiveness between the AirPods Products and claim 1. Reply 11–15. In particular, Petitioner argues that the infringement claim chart, which is mere attorney argument that Apple denies, provides no explanation of how the "remote, network-connected server" and "digital audio player is for transmitting digital audio content to the headphone assembly" limitations are satisfied. *Id.* at 12. Also, Petitioner argues that Patent Owner's reliance on a litigation infringement claim chart is an improper incorporation by reference. *Id.* at 11.

Petitioner also contends that Patent Owner "made no effort to meet its burden to show that AirPods lack unclaimed features responsible for their success." *Id.* at 13 (citing *Fox Factory*, 944 F.3d at 1376). Petitioner identifies the following alleged unclaimed features: "'ultra-low power Apple W1 chip'; 'high-quality audio'; 'industry-leading battery life'; 'one-tap setup'; 'flexible ear tips'; 'vent system to equalize pressure'; 'sweat- and water-resistan[ce]'; 'high dynamic range amplifier'; 'force sensor'; '[a]udio [s]haring'; '[a]nnounce [m]essages'; and integration with Apple's ecosystem." *Id.* (quoting Ex. 2027, 2–3; Ex. 2029, 1–8; citing Ex. 1152 ¶ 44) (alterations in original).

Petitioner adds that Patent Owner's "own employee [and declarant here,] Mr. Blair[,] admitted that headphones' commercial success is affected by cost, weight, comfort, durability, ease of use, battery life, sound quality, moisture tolerance, and brand name—none of which are in the claims." *Id.*

at 14 (citing Ex. 1142 (Mr. Blair's deposition), 15–20). And critically, Petitioner argues that Mr. Blair "admitted that the Apple brand—obviously unclaimed—drives Apple sales." *Id.* (citing Ex. 1142, 20; Ex. 1152 ¶¶ 45–46).

Petitioner also argues that "[t]he irrelevance of the claims to commercial success is confirmed by the failure of [Patent Owner's] own Striva earbuds—which [Patent Owner] argues practiced the '025 patent." *Id.* (citing Ex. 1148, 1; Ex. 1142, 22–30; Ex. 1149, 6).

Last, Petitioner argues that Patent Owner's assertions in other Board proceedings that AirPods have nexus to claims in two other patents dooms its argument here. *Id.* Specifically, Petitioner argues that Patent Owner asserts in IPR2021-00680 that "AirPods are co-extensive with a claim requiring the headphone to receive firmware updates from the same server to which it sends requests—a feature purportedly critical to AirPods' reliability." *Id.* (citing Ex. 1150, 52–60). Petitioner adds that Patent Owner asserts in IPR2021-00381 that "AirPods are co-extensive with a claim reciting two physically-separate earbuds with elongated portions 'extending downward' (like AirPods)—purportedly the invention's 'heart.'" *Id.* (citing Ex. 1151, 24). Petitioner contends that Patent Owner cannot enjoy a presumption of nexus for claim 1 because the features noted above are not recited in claim 1. *Id.* (citing *Fox Factory*, 944 F.3d at 1374; *Lectrosonics*, Paper 33 at 32).

We find that Patent Owner has not met its burden of showing the requisite nexus—that the AirPods Products "embod[y] the claimed features, and [are] coextensive with them." *Fox Factory*, 944 F.3d at 1373. Patent Owner's primary basis for asserting that the AirPods Products embody claim 1 relies on several pages from a claim chart submitted in a district

court proceeding. Ex. 2037, 8–18, 68–78. This extensive incorporation by reference is improper. 37 CFR § 42.6(a)(3) ("[a]rguments must not be incorporated by reference from one document into another document"). Patent Owner contends that it did not improperly incorporate Exhibit 2037 by reference because it explained why the AirPods Products, when combined with an iPhone and in communication with the Apple server system, possesses all the limitations of claim 1. PO Sur-reply 24 (citing PO Resp. 27–29). Patent Owner, however, merely alleges that the AirPods Products comprise certain limitations of claim 1 but does not provide a detailed comparison of the AirPods Products with claim 1 in its Response. PO Resp. 27–30.

In addition, we agree with Petitioner that the unclaimed features that it relies on demonstrate a lack of coextensiveness. *See* Pet. Reply 13 (citing Ex. 2027, 2–3; Ex. 2029, 1–8; Ex. 1152 ¶ 44). We are not persuaded by Patent Owner's argument that Petitioner does not assert that any of the unclaimed features are significant. *See* PO Sur-reply 25 (citing Pet. Reply 13; Ex. 1152 ¶ 44). On the contrary, Petitioner submits evidence—testimony by Patent Owner's declarant, Mr. Blair—showing that several of the unclaimed features (such as comfort, ease of use, battery life, sound quality, and moisture tolerance) affect the commercial success of a headphone product. Pet. Reply 14 (citing Ex. 1142, 15–20). Furthermore, Patent Owner does not address Petitioner's argument (*id.* (citing Ex. 1142, 20; Ex. 1152 ¶¶ 45–46)) that Mr. Blair "admitted that the Apple brand—obviously unclaimed—drives Apple sales."

In view of the above, we are also persuaded by Petitioner's arguments that Patent Owner has not met its burden of showing the requisite nexus

between the AirPods Products and dependent claims 2–10, 40–52, and 54. *See* Pet. Reply 36.

As noted above, Patent Owner may still show nexus by showing that the commercial success of the AirPods Products is the direct result of the unique characteristics of the claimed invention. *See Fox Factory*, 944 F.3d at 1373–74; *Huang*, 100 F.3d at 140. However, the record makes no such showing. Because Patent Owner has not shown a nexus between the claimed invention and the alleged commercial success, Patent Owner has not made a persuasive showing that commercial success evidences non-obviousness.

d) Conclusion

For the foregoing reasons, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Rezvani-446, Rezvani-875, and Skulley renders obvious claim 1.

5. Claims 2, 3, 6, 8, 11–13, 16, 18, 20–22, 25, 27, 39, 52, and 54–56

Petitioner provides reasonable and detailed explanations, supported by the testimony of Dr. Williams and Dr. Casali, indicating where in the references the limitations of claims 2, 3, 6, 8, 11–13, 16, 18, 20–22, 25, 27, 39, 52, and 54–56 are disclosed by Rezvani-446, Rezvani-875, and Skulley. Pet. 28–35. Other than its contentions regarding objective indicia of non-obviousness (entitled to little weight, as discussed above), Patent Owner offers no particular arguments with respect to these dependent claims.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that the combination of Rezvani-446, Rezvani-875, and Skulley renders obvious claims 2, 3, 6, 8, 11–13, 16, 18, 20–22, 25, 27, 39, 52, and

54–56 for the reasons discussed in the Petition and as supported by the testimony of Dr. Williams and Dr. Casali.

F. Ground 1B: Asserted Obviousness Based on Rezvani-446, Rezvani-875, Skulley, and Harada

The parties refer to claims 4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28, 32, 33, 35, 37, 44, 45, 47, 49, and 50 as the "Signal Strength claims." PO Resp. 32–34; Pet. Reply 16–19. Claim 4 is representative of the Signal Strength claims and is reproduced below, with bracketed numbering added to track those used in the Petition:

> 4. The system of claim 3, wherein:
>
> [4A] the mobile, digital audio player is a first digital audio source;
>
> [4B] the system further comprises a second digital audio source that is different from the first digital audio source; and
>
> [4C] the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

Ex. 1001, 18:51–60. Petitioner relies on the additional teachings of Harada and alleges that claims 4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, and 28 would have been obvious over Rezvani-446, Rezvani-875, Skulley, and Harada. Pet. 35–40.

1. Harada

Harada discloses a "dynamic priority connection system" (Ex. 1098 ¶ 78) for "any device[] equipped with [a] short-range wireless communication function" to "connect with a device having the highest availability" (*id.* ¶ 23). "As a specific example, the present invention relates

to an emergency transmission of an electronic device such as a cellular phone and contributes to the improvement of the credibility of the emergency transmission by selecting an optimum device from surrounding communication devices to utilize the communication function thereof." *Id.* ¶ 12. Figure 1 of Harada, reproduced below, illustrates an example:

FIG.1

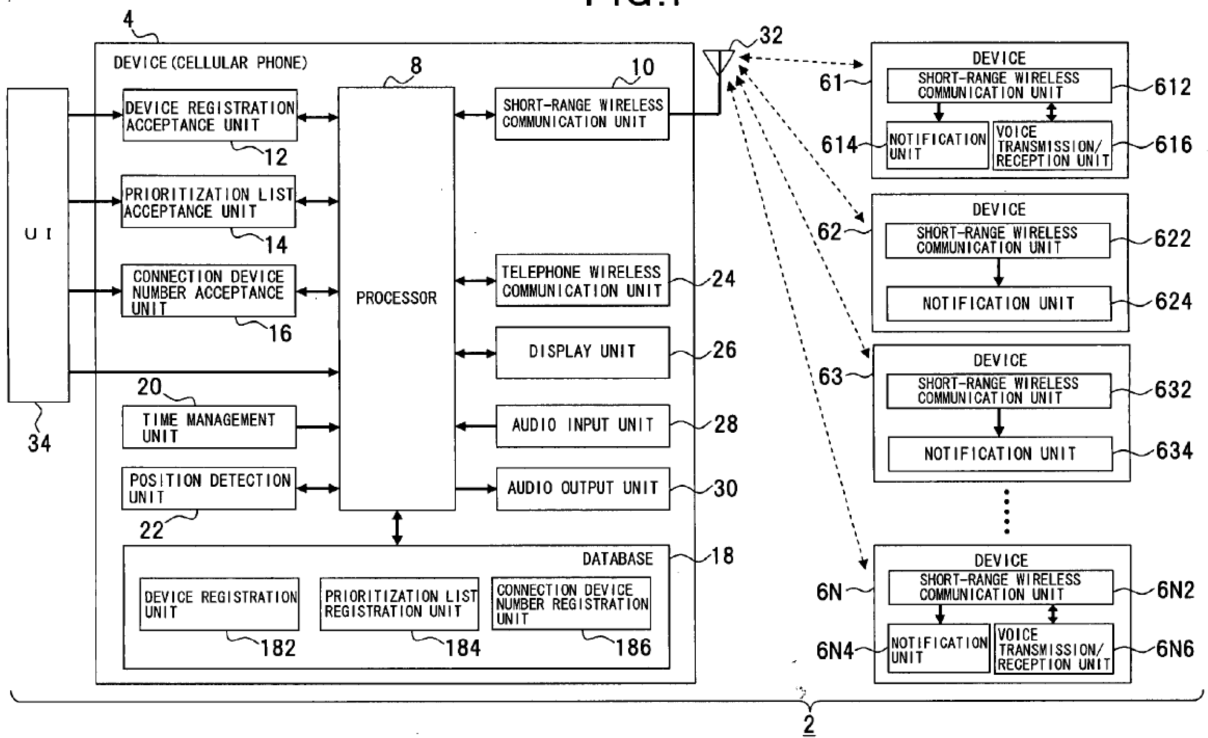

Figure 1 is a block diagram of an inter-device priority connection apparatus, specifically, dynamic priority connection system 2. *Id.* ¶¶ 33, 66–67.

Electronic device 4, e.g., a cellular phone, includes a short-range wireless communication function, such as Bluetooth.[25] *Id.* ¶ 67. Devices 61–6N include the same communication function, are connectable with cellular phone 4 using the communication function, and can be, for example,

[25] Figure 15 of Harada (not shown), is similar to Figure 1, but shows electronic device 60, a device other than a cellular phone, rather than cellular phone 4. *Id.* ¶¶ 145–147, Fig. 15.

cellular phones, personal computers, television sets, automobiles, watches, or GPS apparatus. *Id.* ¶¶ 67, 70. Device registration acceptance unit 12 accepts registration functions from devices 61–6N as connection destination devices, and prioritization list acceptance unit 14 "accepts a prioritization list dependent on information such as position, time, etc. and a prioritization list not dependent on information such as position, time, etc." *Id.* ¶71.

In operation, short-range wireless communication unit 10 monitors received signal levels from the devices of devices 61–6N that are registered. *Id.* ¶ 78.

> If the registered device is a cellular phone, by synchronizing the communication with the cellular phone and performing communication and by having the cellular phone notify the electronic device of a received signal level from a base station of the cellular phone, a remaining battery power amount of the cellular phone and a phone call status, the received signal level, the remaining battery power amount and the phone call status of the registered cellular phone can be managed.

Id. In one example of cellular phone 4 connecting to one or more of devices 61–6N:

> the connection can be achieved with the device with the highest received signal level by monitoring the received signal level of the short-range wireless communication. As an example, if the registered devices are cellular phones, by having the cellular phones notify of a received signal level from a base station of the cellular phone, a remaining battery power amount of the cellular phone and a phone call status, the cellular phones having the remaining battery power amount and not in a phone-calling status are selected and the connection can be achieved with a cellular phone among those cellular phones, which has the highest received signal level from the base station.

Id. ¶ 85. Cellular phone 4 reads the device addresses of the devices of 61–6N that are registered; connects with those devices through the short-range

wireless communication unit; receives signal level, battery level, and call status from each connected device; and connects with one or more of the devices that have a high priority (if the devices are prioritized), enough battery power, and are not already on a call. *Id.* ¶¶ 109–111, Fig. 9.

Harada gives several examples of how its system might be used. In one example, cellular phone 4 sends a textual message to one or more of a television, refrigerator, navigation apparatus, watch, and laptop computer indicating that mail has been received, each of which displays the message. *Id.* ¶¶ 196–210, Fig. 27. In another example, cellular phone 4 sends a scheduling message to one or more such devices, which display the scheduling message. *Id.*¶¶ 211–224, Fig. 28. In another example, a connected device (e.g., a notebook computer or a watch) can change a set mode (e.g., silent mode) of cellular phone 4. *Id.* ¶¶ 225–228, Fig. 29. In another example, one or more devices, in an order of priority (e.g., a laptop computer from work or a watch from outside work) can send a text mail message to cellular phone 4 (e.g., "I'm coming home now"). *Id.* ¶¶ 229–232, Fig. 30. In another example, cellular phone 4 sends an emergency notification to one or more cellular phones, connecting based on received signal levels, remaining battery power, and phone call status of the cellular phones. *Id.* ¶¶ 233–237, Fig. 31.

2. Discussion

Petitioner contends that Rezvani-446's wireless handset 704-2 is "the mobile, digital audio player" recited in claim limitation [4A] as "a first digital audio source." Pet. 38 (citing Ex. 1003 ¶ 206); *see also id.* at 16–18. Petitioner also contends that Rezvani-446's WPM server or a second DAP is the second audio source recited in claim limitation [4B]. *Id.* at 38–39 (citing Ex. 1003 ¶ 207). Petitioner further contends that Harada discloses a

technique for selecting one or more wireless devices from a plurality of such devices. *Id.* at 35–36 (citing Ex. 1098 ¶¶ 11, 14–16, 23, 25, 78, 85, 145–147, code (57), Fig. 15; Ex. 1003 ¶¶ 195–200). According to Petitioner, by using Harada's device selection technique, "Rezvani-Rezvani-Skulley-Harada's headphone assembly 'dynamically select[s]' a connection based on 'a received signal level of a short-range wireless signal' received from available audio-source devices" and "'transitions to play digital audio content received wirelessly from the second digital audio source [*e.g.*, WPM server or MP3 player] via a second wireless communication [*e.g.*, Bluetooth or Wi-Fi] based on, at least a signal strength level [*e.g.*, RSSI] for the second wireless communication link' to the second DAP" as recited in limitation [4C]. *Id.* at 39 (citing Ex. 1098 ¶¶ 15–16, 23, code (57); Ex. 1003 ¶¶ 208–211) (alterations in original). Specifically, Petitioner contends that Harada's teaching would have provided a technique for connecting the headset to alternative audio sources when a connection to a previous audio source was lost or became poor, such as transitioning from the handset to the MP3 player if the handset's batteries die or the WPM server if the handset travels out of range of the headset. *Id.* at 37 (citing Ex. 1003 ¶¶ 201–202).

Petitioner argues that Harada's technique would have been a known technique that would have improved the system of Rezvani-446, Rezvani-875, and Skulley in the same manner, "e.g., by enhancing the device's connection to audio sources and/or identifying alternative sources based on signal strength when another's battery died." *Id.* (citing Ex. 1003 ¶ 203). Petitioner contends that a skilled artisan would have had a reasonable expectation of success in light of Harada's teaching that its technique could be applied to any device equipped with a short-range wireless

communication function. *Id.* at 37–38 (citing Ex. 1098 ¶¶ 23, 145–147; Ex. 1003 ¶ 204).

We are not persuaded by Petitioner's arguments and evidence. Petitioner does not show that Harada teaches playing digital audio content received from multiple sources. Harada's ¶¶ 16, 78, and 85 describe selecting a connection destination device by the received signal strength of the short-range wireless signal or remaining battery life; ¶ 23 lists possible electronic devices, such as cellular phones, personal computers, and watches; and ¶¶ 145–147 make clear that the cellular phone 4 of Figure 1 could be other devices, such as an information processing terminal or household electric device. We do not read these paragraphs as describing a cellular phone (or other device) receiving digital audio content from multiple digital audio content sources.

Paragraph 15 discloses that "one or more devices are dynamically selected based on the prioritization list," but Petitioner does not explain sufficiently why this disclosure would have suggested to one of ordinary skill in the art transitioning from one audio source to another based on signal strength.

At best, ¶ 85 states that "[w]ith such a connection form, the credibility of the connection can be improved and the intelligibility of the phone call can be enhanced." Petitioner cites to, but does not explain, its reliance on ¶ 85. Pet. 35. Paragraph 85 provides a general teaching of connecting to one or more registered devices, which may be cellular phones, based on signal level, battery power, and phone call status. Ex. 1098 ¶ 85. Even if this can be read to teach receiving digital audio content from a cellular phone (which is not taught clearly), it does not teach transitioning from one digital audio source to another. In fact, Harada's examples suggest that

transitioning from audio source to audio source is not contemplated. Rather, as detailed above, Harada's examples are directed to broadcasting a text-based message from a cellular phone to multiple devices or using one such device to reconfigure or send a text-based message to the cellular phone. *Id.* ¶¶ 196–237, Figs. 27–31. We do not find that Harada is limited to those examples. However, Harada does not include the teaching on which Petitioner bases its reliance on Harada, namely, a technique for automatically transitioning from playing digital audio content from one source to playing digital audio content from another source. *See* Pet. 35–39. This claimed feature is missing from the combination of Rezvani-446, Rezvani-875, and Skulley and is not found in Harada.

To the extent Petitioner only argues that Harada shows transitioning from one generic data source to another, and relies instead on Rezvani-446 and Rezvani-875 for sources of digital audio content, Petitioner does not identify where Harada teaches such transitioning. Petitioner's citations (Pet. 35–39 (citing Ex. 1098 ¶¶ 11, 14–16, 20, 23, 25, 31, 78, 85, 145–147)) at most show selecting one or more devices to connect to, from a set of registered devices, based on factors such as registered priority, signal strength, and remaining battery power. In one instance, Harada states that one device might be "concurrently connected" to multiple other devices (Ex. 1098 ¶ 20), but none of Petitioner's citations show a cellular phone (or other device) starting with a connection to a first device and transitioning to a connection to a second device. Thus, even under a more generous reading of Petitioner's combination, Harada still does not teach the transitioning that is missing from the combination of Rezvani-446, Rezvani-875, and Skulley.

Furthermore, we find that Petitioner has not articulated a reason, with rational underpinning, to combine Rezvani-446, Rezvani-875, and Skulley

with a generic teaching of transitioning from one source to another. Petitioner's stated reason for combining the teachings is that "it would have been using a known technique (Harada's device-selection technique) to improve a similar electronic device in the same way (*e.g.*, by enhancing the device's connection to audio sources and/or identifying alternative sources when another's battery died, by identifying the source with the strongest received signals)." Pet. 37 (citing Ex. 1003 ¶ 203). Even if assuming that Harada teaches that it is possible to transition from one device to another, the evidence still does not support a finding that transitioning from one audio source to another based on the relative strengths of the signals received from the two sources is an improvement.[26] Petitioner's evidence in support of this point is no more than conclusory testimony of Dr. Williams (Ex. 1003 ¶ 203), which we do not find credible on this point.[27]

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[26] We recognize that the Supreme Court has articulated other reasons, besides an improvement, that could support a conclusion of obviousness. *See KSR*, 550 U.S. at 415–418; *see also In re Mouttet*, 686 F.3d 1322, 1334 (Fed. Cir. 2012) ("This court has further explained that just because better alternatives exist in the prior art does not mean that an inferior combination is inapt for obviousness purposes."). Here, however, Petitioner expressly relies on the improvement Harada allegedly provides to improve the combination of Rezvani-446, Rezvani-875, and Skulley in the same way. Pet. 37. Because Petitioner has not shown that Harada's technique would improve the combination of Rezvani-446, Rezvani-875, and Skulley, Petitioner has not supported its primary stated reason to combine Harada with Rezvani-446, Rezvani-875, and Skulley.

[27] Petitioner also points to disclosure in Harada that its technique would improve "convenience for the user." Pet. 37 (quoting Ex. 1098 ¶¶ 20, 31). This description, however, explains the benefit of the ability to maintain concurrent connections, not the benefit of transitioning from one connection to another. Ex. 1098 ¶ 20. Thus, Petitioner has not explained persuasively why this disclosure supports its proposed combination.

For the first time at the oral argument, Petitioner argued that with Harada's dynamic selection, "if you walked around the house, you might walk away from your first device, and suddenly have a stronger connection to your second device, and so you would switch that dynamic change from one to the other." Tr. 29:7–15. To the extent that this new argument even should be considered, it is not supported by evidence in the record. For example, Petitioner does not point to any description in Harada that, if a device experiences a lack of a connection or a dropped connection, then the device should connect to something else. Rather, Petitioner's combination is an improvement only in hindsight.

Moreover, it is not clear (even in hindsight) why transitioning from one audio source to another as a user walks from place to place would be an improvement. For example, it might be disorienting and undesirable to switch from a cellular telephone call to a music-playing device when the signal from the music-playing device becomes stronger. Likewise, transitioning from a music-playing device to a television when moving from one room in a house to another might be seen as disadvantageous, at least in the absence of hindsight. Neither the Petition nor Dr. Williams specifies why the behaviors they expect would result from their combinations would have been improvements. Petitioner has not articulated a reason, with rational underpinning, to combine Rezvani-446, Rezvani-875, and Skulley with Harada.

In sum, because Harada does not supply the limitation missing from Rezvani-446, Rezvani-875, and Skulley and because Petitioner has not articulated a reason, with rational underpinning, to combine Rezvani-446, Rezvani-875, and Skulley with Harada, Petitioner has not proved, by a preponderance of the evidence, that claims 4, 5, 7, 9, 14, 15, 17, 19, 23, 24,

26, and 28 would have been obvious over Rezvani-446, Rezvani-875, Skulley, and Harada.

G. Ground 1C: Asserted Obviousness Based on Rezvani-446, Rezvani-875, Skulley, and Hind

Petitioner challenges claims 10 and 38 as unpatentable under 35 U.S.C. § 103(a) based on Rezvani-446, Rezvani-875, Skulley, and Hind. Pet. 40–42. Claims 10 and 38 depend from claim 1 and claim 11, respectively, and both recite that the remote, network-connected server transmits firmware upgrades to the headphone assembly. Ex. 1001, 19:36–38, 22:63–65.

1. Hind

Hind generally discloses "[m]ethods, systems and computer program products which provide secure updates of firmware (i.e., data stored in a programmable memory device of a processing system)." Ex. 1019, code (57). Hind explains that "[m]any devices today" include "software instructions embedded in the device." Ex. 1019, 1:23–25. This "software" is "often called firmware because of its persistent association with the device hardware operations." *Id.* at 1:26–28. "[I]t was historically placed in read-only memory (ROM) and was activated when the device was powered on." *Id.* at 1:28–30. Hind explains that over time, "it was recognized that firmware, like other forms of software, might be subject to coding mistakes and the over the lifetime of the device there was a need to modify the functional characteristics of the device, for example, to adapt it to a new target environment." *Id.* at 1:29–33.

Hind states that "[t]he extensive increase in network connectivity in recent years has resulted in an increase in the number of firmware-driven

devices that allow personality updates," even though these updates may present "security problems." *Id.* at 1:44–48.

Hind distributes "firmware updates," which may include "corresponding certificates associated with a firmware update." *Id.* at 18:46–51. "[S]ervers or other such devices known to those of skill in the art" may provide the firmware updates over the "Internet or an intranet" to "updateable devices" that "may be any type of computing device capable of carrying out some or all of the operations described" in Hind. *Id.* at 18:51–64, Fig. 10. Hind teaches that its "invention" applies to "wireless stereo headphones" with a "microprocessor" to receive such "secure[] upgrade[s]" "by means of a microcode download transmitted wirelessly from, for example, the Internet." *Id.* at 19:40–47.

2. Discussion

Petitioner relies on Hind as disclosing communicating firmware to a device, such as wireless stereo headphones, through a network connection. Pet. 40 (citing Ex. 1019, 1:23–25, 1:40–44, 18:51–64, 19:40–53, Fig. 10; Ex. 1003 ¶¶ 235–240). Petitioner also provides reasons, supported with the testimony of Dr. Williams, for why one of ordinary skill in the art would have configured, with a reasonable expectation of success, the processor in the combination of Rezvani-446, Rezvani-875, and Skulley to receive firmware updates from the server. *Id.* at 40–42 (citing Ex. 1019, 1:23–55, 19:40–57; Ex. 1097 ¶¶ 4, 26–28; Ex. 1016 ¶¶ 19–21, 33–37; Ex. 1003 ¶¶ 241–246).

Patent Owner argues that one of the passages from Hind cited by Petitioner discloses that a pair of wireless headphones could be securely upgraded via a *microcode* download. PO Resp. 56 (citing Ex. 1019, 19:40–47). According to Patent Owner, however, neither Petitioner nor its experts

provides any insight or explanation as to how a microcode download satisfies the claimed firmware upgrades. *Id.* at 56–57 (citing Pet. 40–41; Ex. 1003 ¶ 246).

In its Reply, Petitioner argues that "'[m]icrocode' is another name for 'firmware.'" Pet. Reply 33 (citing Ex. 1143, 1:13–15 ("microcode[] alternatively called firmware"); Ex. 1144, 10:14–15 ("microcode (i.e., firmware)"); Ex. 1152 ¶¶ 73–76). Relying on record evidence, Petitioner argues that "[t]his is consistent with Hind's explanation that firmware '***control[s]***' a device's 'computational elements . . . to give the device its ***functional*** personality' ([Ex. 1019,] 1:23–29) and that microcode likewise '***control[s]*** a digital signal processor' and adds 'new functions' to it ([*id.* at] 19:37–47)." Pet. Reply 33. Dr. Williams testifies that "[s]imply put, 'microcode' is a form of 'firmware' and "conventionally refers to a type of firmware that is intended for a device's processor, and POSAs understood 'microcode' to be synonymous with 'firmware.'" Ex.1152 ¶ 74 (citing Ex. 1143, 1:13–15; Ex. 1144, 10:14–15). We credit Dr. Williams' uncontroverted testimony on this point, which we find well-reasoned and supported by evidence of record.

Furthermore, Petitioner argues "setting aside 'microcode' in Hind Column 19, Grounds 1C and 1H also relied on Hind's numerous disclosures of downloading '***firmware***' to devices from a server, and the benefits of doing so." Reply 33 (citing Pet. 40–42; Ex. 1003 ¶¶ 238–246). As one example, Dr. Williams relies on Hind's statement that "firmware, like other forms of software, might be subject to coding mistakes and that over the lifetime of the device there was a need to ***modify the functional characteristics*** of the device, for example, to ***adapt it to a new target environment***." Ex. 1003 ¶ 243 (quoting Ex. 1019, 1:23–54). In addition,

"[a]s Hind taught, firmware allowed for the device manufacturer to add 'performance enhancements or . . . to accommodate new parameters not available at the time of distribution of the product' and repair 'coding errors.'" *Id.* (quoting Ex. 1019, 1:34–37, 19:54–57). In view of the above, we agree with Petitioner that Hind contains several disclosures of downloading firmware.

In its Sur-reply, Patent Owner argues that "[n]either the Petition nor Williams's original declaration (BOSE-1003) opined on the relationship between microcode and firmware," so that Petitioner's Reply argument and evidence is improper. Sur-reply 22. Contrary to this argument, the Petition provides ample notice that Petitioner relies on microcode as firmware (and also, Hind's firmware teachings in general as noted above). For example, the following statement in the Petition directly ties microcode and firmware together:

> Hind recognizes remote-*firmware-updates* were compatible with "wireless stereo headphones containing a microprocessor [and] memory" (as in Rezvani-Rezvani-Skulley) by "means of a *microcode* download transmitted wirelessly from" servers accessible over a wireless connection to the Internet, and Rezvani-Rezvani-Skulley's headset already had functionality to exchange software with the WPM server via its Internet connection.

Pet. 41–42 (emphases added) (citing Ex. 1019, 19:40–47; Ex. 1016 ¶¶ 19–21, 33–37; Ex. 1097 ¶¶ 26–28; Ex. 1003 ¶ 246).

Based on the foregoing discussion, Patent Owner's arguments do not undermine Petitioner's persuasive showing that Hind teaches the firmware upgrades required by claims 10 and 38. In addition, as discussed above (*see supra* § II.E.4.c), Patent Owner's objective indicia of obviousness (evidence of commercial success) are entitled to little weight because Patent Owner

has not shown a nexus between the claimed invention and the alleged commercial success.

For the foregoing reasons, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Rezvani-446, Rezvani-875, Skulley, and Hind renders obvious claims 10 and 38.

H. Ground 1D: Asserted Obviousness Based on Rezvani-446, Rezvani-875, Skulley, and Davis

Petitioner challenges claims 29–31, 34, 36, and 53 as unpatentable under 35 U.S.C. § 103(a) based on Rezvani-446, Rezvani-875, Skulley, and Davis. Pet. 42–47. Claims 29 and 53 depend from claim 11 and claim 1, respectively, and further recite that each of the earphones comprises (1) "an adjustable, curved hanger bar that sits upon an upper external curvature of a user's ear, behind the an upper portion of an auricula of the user's ear, when the headphone assembly is worn by the user," and (2) "a body connected to the hanger bar, wherein the earphone extends from the body into the user's ear when the headphone assembly is worn by the user." Ex. 1001, 21:53–61, 24:42–50. Claims 30, 34, and 36 depend from claim 29 and add the same subject matter as claims 2, 3, and 8, respectively. *Id.* at 21:62–22:3, 22:32–39, 22:50–52. Claim 31 depends from claim 30 and adds the same subject matter as claim 8. *Id.* at 22:4–11.

1. Davis

Davis relates to communications headsets, particularly "self-supporting, monaural headsets containing a microphone and a receiver." Ex. 1033, 1:5–7. The invention of Davis is intended to "overcome[] the limitations of conventional headset designs by providing a lightweight, self-supporting headset which can be comfortably and securely fitted to a wide range of users without undue individual attention." *Id.* at 2:45–49.

Figure 2 is reproduced below.

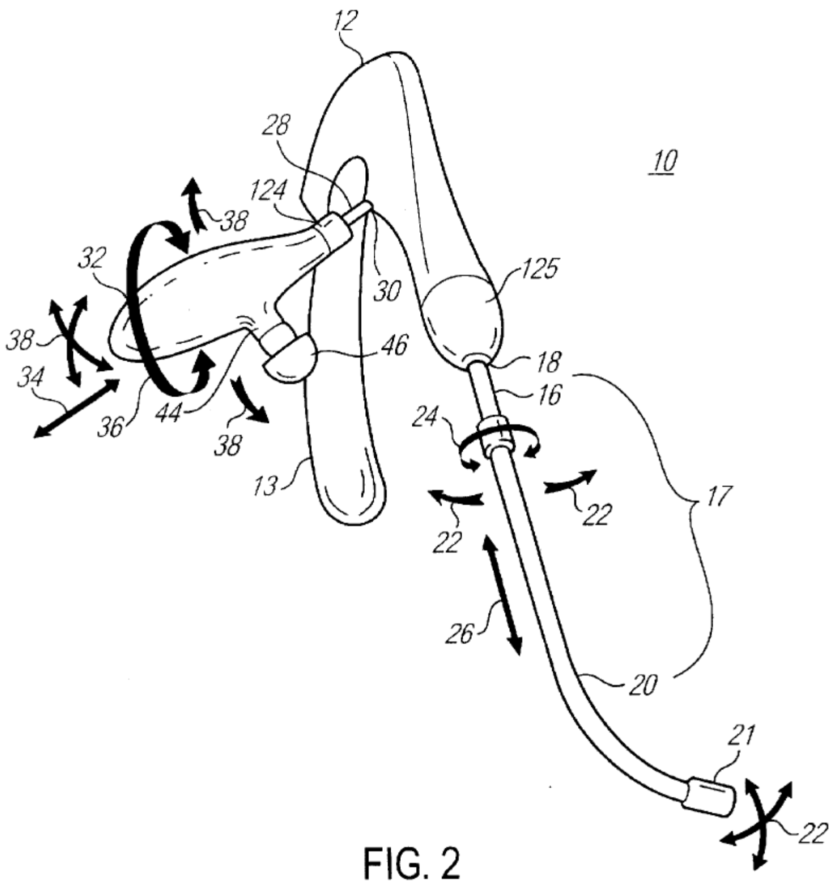


FIG. 2

Figure 2 is a front view of one embodiment of a headset. Ex. 1033, 4:17, 4:39–41. Headset 10 includes headset enclosure 12 having arcuate earhook 13. *Id.* at 4:41–42. Voice transmitter 17 and receiver enclosure 32 are coupled to headset enclosure 12. *Id.* at 4:45–46. An attachment member, such as ball tube 28, couples receiver enclosure 32 to headset enclosure 12 to facilitate the angular adjustment of receiver enclosure 32 relative to headset enclosure 12. *Id.* at 4:49–57. Receiver enclosure 32 further includes earbud 46. *Id.* at 6:32–35. Voice transmitter 17 includes voice tube arm 16 voice tube 20 having audio filter cap 21 at its distal end. *Id.* at 5:21–22, 5:36–37.

2. Discussion

Petitioner relies on Davis as disclosing in-the-ear type earphones having an arcuate ear hook or hanger bar 13. Pet. 42–43 (citing Ex. 1033, 2:45–3:12, 7:59–63, 8:48–65, Figs. 1, 8; Ex. 1005 ¶¶ 152–155). Petitioner argues that one of ordinary skill in the art would have had reasons to implement Rezvani-Rezvani-Skulley's headset with Davis's in-ear, hanger bar design. *Id.*at 43. Namely, Petitioner argues that Skulley explicitly suggests the modification by disclosing that Davis describes exemplary "in-the-ear" type earphones (*id.* at 44 (citing Ex. 1017, 1:25–27; Ex. 1005 ¶ 145)) and Davis independently suggests the modification because its design "is 'lightweight, self-supporting' and 'can be comfortably and securely fitted to a wide range of users'" (*id.* (citing Ex. 1033, 2:45–51; Ex. 1005 ¶¶ 133, 146–151)). Petitioner contends that one of ordinary skill in the art "would reasonably have expected success in this combination because Skulley identifies Davis as describing an exemplary in-ear design and Davis teaches 'the shape and size of both the headset enclosure and the receiver could vary' to accommodate different locations for 'the electronics.'" *Id.* (citing Ex. 1033, 9:35–10:5; Ex. 1003 ¶¶ 253–257; Ex. 1005 ¶¶ 138, 155).

Petitioner argues that the Rezvani-Rezvani-Skulley-Davis combination implements the form-factor of Davis's Figure 1 and thus includes earhook 13 corresponding to the curved hanger bar. *Id.* at 45 (citing Ex. 1033, 2:45–3:12, 8:48–65; Ex. 1005 ¶¶ 152–153). Petitioner also argues that "this form-factor has a 'body . . . 12' connected to 'earhook 13' (hanger bar), and 'earbud (earphone) 46,' extending from body 12 that can be 'positioned within the concha of the [user's] ear' when worn by a user." *Id.* at 46 (citing Ex. 1033, 6:35–48, 8:53–9:34, Figs. 1, 8; Ex. 1017, 1:25–28;

Ex. 1005 ¶ 154). Petitioner thus asserts that the proposed combination discloses the limitations of claims 29–31, 34, 36, and 53. *Id.* at 46–47.

Patent Owner argues that claims 29 and 53 require that the earphone extends from the body, but

> Davis's earbud 46, which Petitioner alleges is the earphone of claims 29 and 53, does not extend from Davis's headset enclosure 12, which Petitioner alleges is the body of claims 29 and 53. Instead, Davis's earbud 46 extends from the receiver enclosure 32, which is separate from Davis's headset enclosure.

PO Resp. 53–54 (citing Ex. 2024 ¶ 75; Ex. 2025 ¶ 21; Ex. 1033, 4:49–53, 6:32–35, Figs. 1–3B, 6–9). For this reason, Patent Owner asserts that Petitioner's proposed combination fails to disclose all limitations of claim 29 (and thus claims 30, 31, and 34 depending therefrom) and claim 53. *Id.* at 54 (citing Ex. 2024 ¶¶ 74–79).

Petitioner disputes this argument, contending that Patent Owner "interprets 'extends from' narrowly to exclude indirect extensions—but the '025 patent specification forecloses that interpretation." Pet. Reply 31. In support of this contention, Petitioner points to Figures 1D–1E of the '025 patent, which Petitioner asserts depict the only hanger-bar embodiment of the '025 patent. *Id.* (citing Ex. 1001, 3:66–4:20; Ex. 1141, 133–135). Petitioner submits annotated versions of Figures 1D–1E of the '025 patent, which we reproduce below.

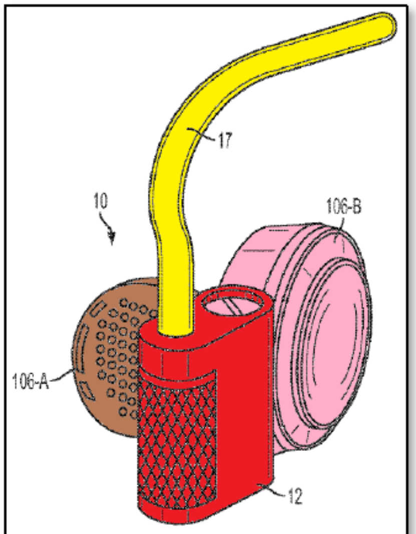


FIG. 1D

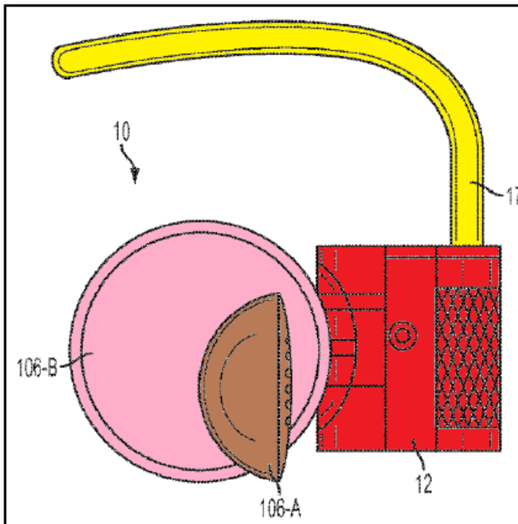


FIG. 1E

Pet. Reply 32. For these annotated versions of the figures, Petitioner adds (1) yellow overlay to hanger bar 17, (2) red overlay to body 12, (3) brown overlay to speaker element 106-A, and (4) pink overlay to speaker element 106-B. *Id.* Referring to these annotated Figures, Petitioner asserts that speaker 106-A is disclosed as the element that extends into the user's ear, but "speaker 106-A does not extend ***directly*** from body 12, but rather ***indirectly*** because speaker 106-B (pink) separates the two." *Id.* at 31 (citing Ex. 1001, 4:5–9). In Petitioner's view, "[c]onstruing 'extends from' to require direct connection would improperly exclude the '025 patent's sole hanger-bar embodiment." *Id.*

Patent Owner argues that this argument mischaracterizes the '025 patent. PO Sur-reply 21. In particular, Patent Owner contends that claim 1, from which claims 29 and 53 depend, recites that each of the claimed earphones "comprises an acoustic transducer," where the indefinite article "an" means that the claim covers earphones having one or more acoustic transducers or speakers. *Id.* (citing *KCJ Corp. v. Kinetic Concepts, Inc.*, 223 F.3d 1351, 1356 (Fed. Cir. 2000)). According to Patent Owner, "[t]he 'one

or more speakers' are the 'dual speaker' element comprising speaker 106-A (brown) and speaker 106-B (pink). This dual speaker element extends ***directly*** from the body 12 (red) and into the user's ear. Particularly, speaker 106-A (brown) extends into the user's ear." *Id.* (citing Ex.1001, 4:5–7). In view of this assertion, Patent Owner argues that "the '025 Patent's intrinsic evidence reinforces that the speaker is directly connected to the body." *Id.*

Patent Owner's argument relies on the premise that the "earphone" of claims 29 and 53 comprises both speaker 106-A and speaker 106-B. Claims 29 and 53, however, require the "earphone" (not an individual speaker) to extend into the user's ear. Thus, under Patent Owner's premise, both speakers 106-A and 106-B would have to extend into the ear. However, the '025 patent discloses that speaker 106-A is sized to fit into the user's ear but speaker 106-B is not. As such, we are not persuaded that the earphone must be directly connected to the body. Instead, we are persuaded by Petitioner's argument that the earphone of claims 29 and 53 can extend indirectly from the body in view of the '025 patent's disclosure of speaker 106-A extending indirectly from body 12.

For the foregoing reasons, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Rezvani-446, Rezvani-875, Skulley, and Davis renders obvious claims 29–31, 34, 36, and 53.

I. Ground 1E: Asserted Obviousness Based on Rezvani-446, Rezvani-875, Skulley, Davis, and Harada

Petitioner challenges claims 32, 33, 35, and 37 as unpatentable under 35 U.S.C. § 103(a) based on Rezvani-446, Rezvani-875, Skulley, Davis, and Harada. Pet. 47. Claims 32, 33, 35, and 37 are Signal Strength claims, and Petitioner asserts that "[f]or the same reasons POSAs would have

implemented Rezvani-Rezvani-Skulley in view of Harada to make the claimed transition (§VI.A.2.c *supra*), POSAs would have implemented Rezvani-Rezvani-Skulley-Davis in view of Harada to make this transition, and thus Rezvani-Rezvani-Skulley-Davis-Harada meets claims 32–33, 35, and 37." *Id.* (citing Ex. 1003 ¶¶ 274–283).

We have determined, however, that the arguments and evidence set forth by Petitioner did not prove, by a preponderance of the evidence, that Signal Strength claims 4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, and 28 would have been obvious over Revani-446, Rezvani-875, Skulley, and Harada. *See supra* § II.F.2. For the same reasons discussed above, therefore, we determine that Petitioner has not proved, by a preponderance of the evidence, that claims 32, 33, 35, and 37 would have been obvious over Rezvani-446, Rezvani-875, Skulley, Davis, and Harada.

J. Ground 1F: Asserted Obviousness Based on Rezvani-446, Rezvani-875, Skulley, Davis, and Oh

Petitioner challenges claims 40–43, 46, and 48 as unpatentable under 35 U.S.C. § 103(a) based on Rezvani-446, Rezvani-875, Skulley, Davis, and Oh. Pet. 47–54. Claim 40 depends from claim 1 and further recites that each of the earphones comprises "at least one acoustic transducer; a wireless communication circuit; a body portion that sits at least partially in an ear of the user when the headphone assembly is worn by the user; and an elongated portion that extends from the body portion." Ex. 1001, 23:1–8. Claim 41 depends from claim 40 and adds "a docking station for charging at least one of the first and second earphones." *Id.* at 23:9–11.

1. Oh

Oh relates to wireless stereo earphones that fit into the ears. Ex. 1099 ¶¶ 1, 19. Figure 1 of Oh is reproduced below.

[Fig. 1]

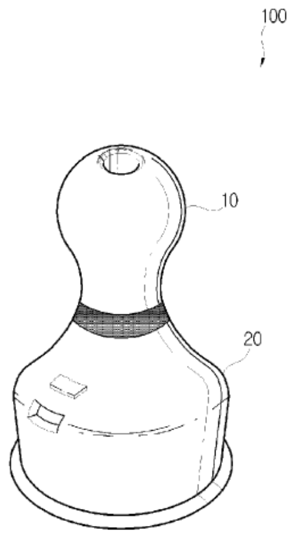


Figure 1 above illustrates wireless earphone 100 that is shaped as an earplug and includes inserting unit 10 for placing in an ear of a user and main body 20, which includes an antenna, battery, speaker, and a signal processing circuit for performing a wireless headset function. Ex. 1099 ¶ 30. Each earphone has the same hardware configuration. *Id.* ¶ 41.

Figure 5 is reproduced below.

[Fig. 5]

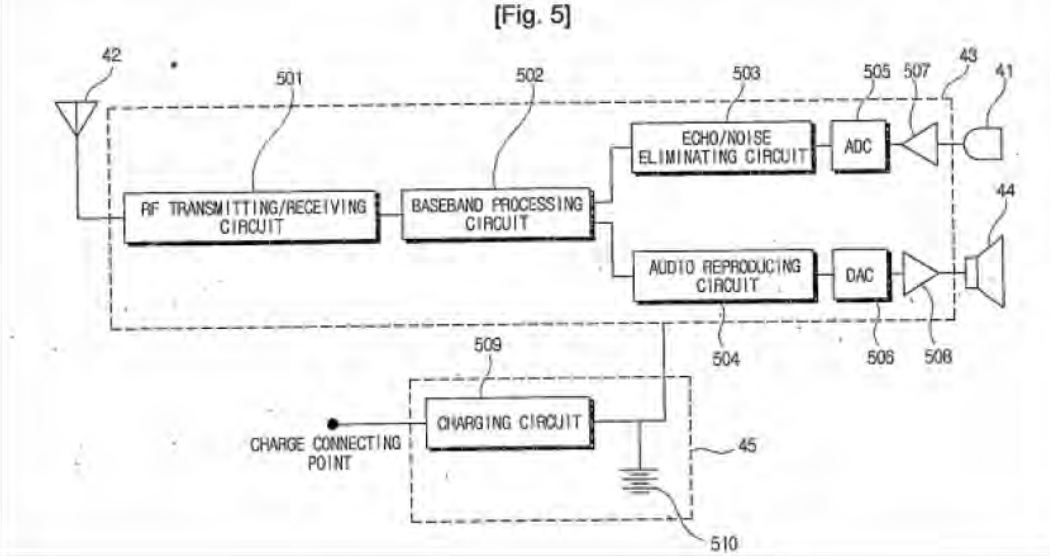


Figure 5 illustrates the hardware circuit in each earphone, including antenna 42, speaker 44, signal processing circuit 43, battery 45 with rechargeable battery 510 and charging circuit 509, RF transmitting/receiving circuit 501 (e.g., for WLAN/Wi-Fi or Bluetooth), baseband processing circuit 502, and echo eliminating circuit 503, which may include a digital signal processor ("DSP"). Ex. 1099 ¶¶ 34, 37, 41, 44, 50, 52.

Oh teaches charging its earphones by inserting them into mounting unit 201 connected to the "mobile communication terminal," e.g., mobile phone. Ex. 1099 ¶¶ 17, 33, 38, 50. Oh also describes a DSP with an "echo eliminating circuit." *Id.* ¶ 40. The DSP "determines when the received audio[] signal is mixed with a transmitting audio signal [during a call], and eliminates the mixed signal." *Id.*

2. Discussion

Petitioner relies on Oh as disclosing in-the-ear type earphones having a speaker and an RF transmitting/receiving circuit. Pet. 48 (citing Ex. 1099 ¶¶ 1, 19, 34, 37, 41, 52, Fig. 5; Ex. 1005 ¶¶ 158–163). Also, Petitioner argues that Oh teaches charging its earphones in a docking station. *Id.* at 48–49 (citing Ex. 1099 ¶¶ 17, 33, 38, 50 Figs. 1, 4; Ex. 1003 ¶¶ 285–292).

Petitioner argues that, in view of Oh's teachings, one of ordinary skill in the art would have had reasons to implement the Rezvani-Rezvani-Skulley-Davis "earbud" (discussed above in connection to Ground 1D) as a true-wireless design, where "each earbud (1) included Rezvani-875's subsystem components (*e.g.*, speaker, transceiver, battery), (2) had no wire connecting the earphones, and (3) was dockable (*e.g.*, in handset 704-2 or MP3 player) to recharge the batteries." *Id.* at 50 (citing Ex. 1003 ¶¶ 293–295). Namely, Petitioner argues that Oh taught that a true-wireless design was beneficial due to economic benefits such as needing to purchase only

one replacement if one earphone is lost or broken. *Id.* at 50 (citing Ex. 1099 ¶ 41; Ex. 1003 ¶ 296; Ex. 1005 ¶¶ 77–80). Petitioner also argues that Oh teaches that charging earphones in a docking station makes them easy to carry and protects them from being lost. *Id.* (citing Ex. 1099 ¶ 19; Ex. 1003 ¶ 296; Ex. 1005 ¶ 161). In addition, Petitioner argues that the proposed combination would have been applying "a known technique (true-wireless earphones charged via a docking station) to improve similar devices (headphones) in the same way (providing true-wireless headphones with a convenient place to be stored and charges)." *Id.* at 50–51 (citing Ex. 1099 ¶¶ 19, 41; Ex. 1003 ¶ 297; Ex. 1005 ¶¶ 77–80).

Petitioner contends that one of ordinary skill in the art would reasonably have expected success in this combination because "implementing earphones with identical components and charging them in a docking station were well-known techniques within a POSA's ordinary skill, and Davis teaches its earbuds are detachable and their 'shape and size . . . could vary.'" *Id.* at 51 (citing Ex. 1033, 9:35–50; Ex. 1099 ¶ 33; Ex. 1003 ¶ 298; Ex. 1005 ¶¶ 138, 155, 162–163).

Regarding the limitations of claim 40, Petitioner argues that the earphones in this combination each comprise at least one acoustic transducer to output a stereo audio signal. *Id.* (citing Ex. 1099 ¶¶ 41–42; Ex. 1016 ¶ 20; Ex. 1003 ¶ 299; Ex. 1005 ¶ 47). Petitioner also argues that the combination "uses Davis's earbud form-factor in a true-wireless design, which Oh taught includes a wireless communication circuit (here, Rezvani-875's RF system 220) in each earphone." *Id.* at 51–52 (citing Ex. 1099 ¶¶ 12, 82; Ex. 1003 ¶ 300; Ex. 1005 ¶¶ 77–80). Petitioner contends that Davis's earbud 46 is the claimed "body portion that sits at least partially in an ear of the user when the headphone assembly is worn by the user." *Id.* at 52 (citing Ex. 1033,

6:34–35, 7:59–63, Fig. 3b; Ex. 1005 ¶¶ 152–154). According to Petitioner, Davis's receiver enclosure 32, earhook 13, and voice tube 20 are elongated portions that extend from the body portion (i.e., earbud 46). *Id.* at 53 (citing Ex. 1033, 6:34–35, 7:9–10, 7:59–63, Fig. 3b; Ex. 1005 ¶ 154).

First, Patent Owner argues that one of ordinary skill in the art "would not understand Davis's earbud to be the 'body portion' because the 'body portion' is the central or main portion of the earphone. PO Resp. 43 (citing Ex. 2024 ¶ 60). This argument, however, is not persuasive because it is predicated on Patent Owner's proposed construction of the "body portion," which we decline to adopt for the reasons set forth above. *See supra* § II.D.2. Instead, we determine that, consistent with our construction of "body portion" as "a portion or section of the earphone that forms a body," Davis's earbud 46 satisfies the claimed "body portion that sits at least partially in an ear of the user when the headphone assembly is worn by the user."

Patent Owner also presents arguments asserting that the claims would not have been obvious if Davis's receiver enclosure 32 is considered the "body portion." PO Resp. 43–47. These arguments, however, are not applicable or persuasive because Petitioner does not assert that receiver enclosure 32 is considered the "body portion."

Patent Owner further contends that, if earbud 46 is considered the "body portion," neither Davis's earhook 13 or voice tube 20 would satisfy the claimed "elongated portion" because neither element extends from the earbud 46. *Id.* at 47. This argument is not persuasive because Petitioner does not rely on only earhook 13 or voice tube 20 as elongated portions; instead, Petitioner identifies three alternative structures of Davis: receiver enclosure 32, earhook 13, and voice tube 20. Pet. 53; *see also* Pet. Reply

24–25 (arguing that receiver enclosure 32 is an "elongated portion" that extends from earbud 46). We agree with Petitioner that receiver enclosure 32 satisfies the "elongated portion" as claimed.

Next, Patent Owner argues that Oh "teaches against Petitioner's proposed combinations for Ground 1F-1H because Oh stresses miniaturization of the earbuds, which is incompatible with Davis's large headset." PO Resp. 49 (citing Ex. 2024 ¶ 70). Patent Owner contends that Oh describes difficulties in miniaturizing wireless headphones or headset because of microphone placement. *Id.* (citing Ex. 1099 ¶¶ 14, 35). Accordingly, Patent Owner asserts that one of ordinary skill in the art "would not be motivated to also use Davis's large (i.e., non-miniaturized) headset design, with its voice tube that extends toward the user's mouth, in light of Oh's teaching to miniaturize the earbuds by using a bone-conducting sensor in the earhole portion of the earbud." *Id.* at 50 (citing Ex. 2024 ¶¶ 68–70).

Petitioner responds by arguing that Patent Owner's argument misrepresents the proposed combination. Pet. Reply 27. Specifically, Petitioner argues that the proposed combination does not include Oh's components and relies on Oh only for teaching the benefits of true-wireless headphones. *Id.* (citing Pet. 50). We agree that the proposed combination does not rely on, or even suggest, incorporating Oh's teachings of miniaturization of earbuds. Therefore, we determine that Oh does not teach away from the proposed combination.

In addition, as discussed above (*see supra* § II.E.4.c), Patent Owner's objective indicia of obviousness (evidence of commercial success) are entitled to little weight because Patent Owner has not shown a nexus between the claimed invention and the alleged commercial success.

For the foregoing reasons, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Rezvani-446, Rezvani-875, Skulley, Davis, and Oh renders obvious claim 40. Regarding claims 41–43, 46, and 48, which depend from claim 40, Petitioner provides reasonable and detailed explanations, supported by the testimony of Dr. Williams and Dr. Casali, indicating where in the references the limitations of these claims are disclosed. Pet. 54. Other than its contentions regarding objective indicia of non-obviousness (discussed above), Patent Owner offers no particular arguments with respect to these dependent claims.

We have considered the evidence and arguments of record, including Patent Owner's contentions regarding objective indicia of non-obviousness (entitled to little weight, as discussed above), and determine that Petitioner has demonstrated by a preponderance of the evidence that the combination of Rezvani-446, Rezvani-875, Skulley, Davis, and Oh renders obvious claims 41–43, 46, and 48 for the reasons discussed in the Petition and as supported by the testimony of Dr. Williams and Dr. Casali.

K. Ground 1G: Asserted Obviousness Based on Rezvani-446, Rezvani-875, Skulley, Davis, Oh, and Harada

Petitioner challenges claims 44, 45, 47, 49, and 50 as unpatentable under 35 U.S.C. § 103(a) based on Rezvani-446, Rezvani-875, Skulley, Davis, Oh, and Harada. Pet. 54–55. Claims 44, 45, 47, 49, and 50 are Signal Strength claims, and Petitioner asserts that "[f]or the same reasons POSAs would have implemented Rezvani-Rezvani-Skulley in view of Harada to make the claimed transition Ground 1B), POSAs would have implemented Rezvani-Rezvani-Skulley-Davis-Oh in view of Harada to make

this transition" and "Rezvani-Rezvani-Skulley-Davis-Oh-Harada thus meets claims 44–45, 47, and 49–50." *Id.* at 55 (citing Ex. 1003 ¶¶ 314–325).

We have determined, however, that the arguments and evidence set forth by Petitioner did not prove, by a preponderance of the evidence, that Signal Strength claims 4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, and 28 would have been obvious over Revani-446, Rezvani-875, Skulley, and Harada. *See supra* § II.F.2. For the same reasons discussed above, therefore, we determine that Petitioner has not proved, by a preponderance of the evidence, that claims 44, 45, 47, 49, and 50 would have been obvious over Rezvani-446, Rezvani-875, Skulley, Davis, Oh, and Harada.

L. Ground 1H: Asserted Obviousness Based on Rezvani-446, Rezvani-875, Skulley, Davis, Oh, and Hind

Petitioner challenges claim 51 as unpatentable under 35 U.S.C. § 103(a) based on Rezvani-446, Rezvani-875, Skulley, Davis, Oh, and Hind. Pet. 55. Claims 51 depends from claim 40 and, similar to claims 10 and 38 addressed above in Ground 1C, adds that the remote, network-connected server transmits firmware upgrades to the headphone assembly. Ex. 1001, 24:33–35. Petitioner asserts that "[f]or the same reasons POSAs would have implemented Rezvani-Rezvani-Skulley in view of Hind to receive firmware upgrades from the WPM server (Ground 1C), POSAs would have implemented Rezvani-Rezvani-Skulley-Davis-Oh in view of Hind to receive firmware upgrades from that server" and "Rezvani-Rezvani-Skulley-Davis-Oh-Hind thus meets claim 51." Pet. 55 (citing Ex. 1003 ¶¶ 326–329).

For this ground, Patent Owner relies on the same arguments made in connection with claims 10 and 38 in Ground 1C. PO Resp. 56–57; PO Sur-reply 22–24. As discussed above, we find these arguments unpersuasive and determine that Petitioner's reliance on Hind was sufficient to establish by a

preponderance of the evidence that that claims 10 and 38 are unpatentable. *See supra* § II.G.2. For the same reasons, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Rezvani-Rezvani-Skulley-Davis-Oh-Hind renders obvious claim 51.

M. Ground 2A: Asserted Obviousness Based on Schrager and Goldstein

Petitioner asserts that claims 1–3, 6, 8, 10–13, 16, 18, 38–43, 46, 48, 51, 52, 54, and 56 are unpatentable under 35 U.S.C. § 103(a) based on Schrager and Goldstein. Pet. 56–76. Patent Owner provides arguments addressing this asserted ground of unpatentability. PO Resp. 20–23. We first summarize the references and then address the parties' contentions.

1. Schrager

Schrager discloses "a portable electronic device which can include one or more of an AM/FM radio, a music player, a short distance radio, a voice memo pad, a cellular telephone, a global positioning system (GPS) receiver, an AM/FM radio interface, and a transponder." Ex. 1101, 4:55–59. Each of these units can be operated in a hands-free manner via voice commands. *Id.* at 4:60–62. Figure 1 of Schrager is reproduced below.

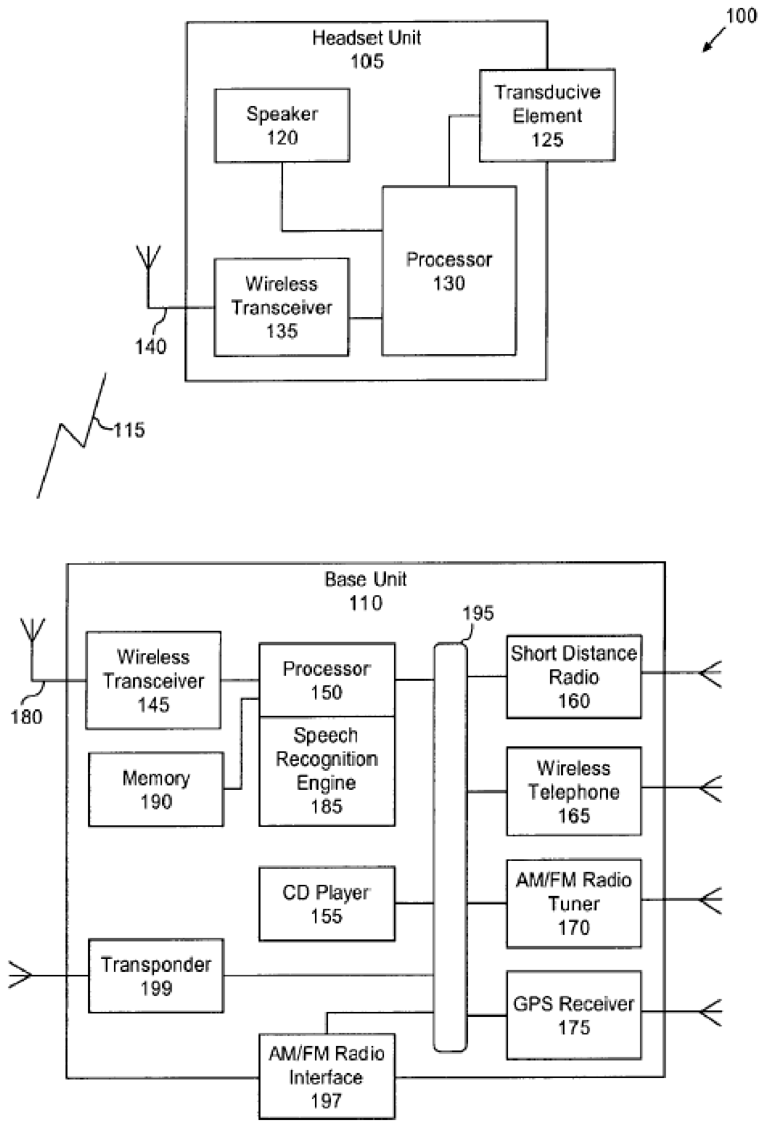


FIG. 1

Figure 1 is a schematic diagram illustrating voice-controlled multimedia and communications device 100. *Id.* at 4:38–40, 4:66–5:2. Device 100 includes headset unit 105 and base unit 110 that communicate via wireless communication link 115. *Id.* at 5:2–5. Headset unit 105 includes speaker 120, transducive element 125, processor 130, wireless transceiver 135, and antenna 140. *Id.* at 5:5–8. Processor 130 can receive audio signals, control signals, and other data from base unit 110 through wireless transceiver 135.

Id. at 5:44–46. Wireless transceiver 135 can communicate with base unit 110 using any of a variety of short-range wireless protocols, including Bluetooth technology. *Id.* at 6:12–16.

Base unit 110 can include wireless transceiver 145, processor 150, and compact disc ("CD") player 155 or other music source. *Id.* at 6:62–64. Wireless transceiver 145 can be matched to the headset unit's wireless transceiver 135 through antenna 180. *Id.* at 6:67–7:3.

2. Goldstein

Goldstein relates to the storage and recall of audio content, such as the storage and playing of music or verbal content on a system built into a headphone. Ex. 1026 ¶ 2. "At least one exemplary embodiment is directed to a system for Personalized Services delivered to a Personal Audio Assistant incorporated within an earpiece (e.g., earbuds, headphones)." *Id.* ¶ 17. The Personal Audio Assistant (PAA) is incorporated into an earpiece or headphone system and is capable of digital audio playback. *Id.* ¶ 18. Audio content is seamlessly downloaded to the Personal Audio Assistant and is managed from a "Server system." *Id.* ¶ 19.

Figure 1 of Goldstein is reproduced below.

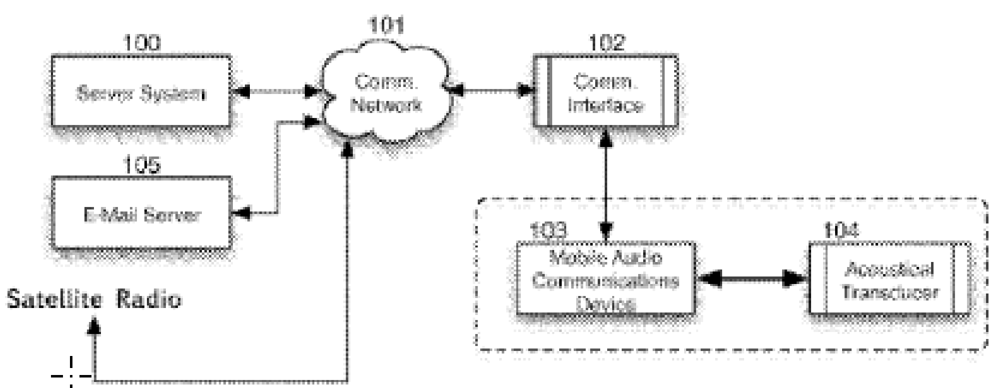


Fig. 1

Figure 1 illustrates the connection between earpiece device 103, 104 and communication network 101. *Id.* ¶¶ 6, 65. Communication network 101 can

be operatively connected to server system 100, e-mail server 105, or both via a wired or wireless connection. *Id.* ¶ 65.

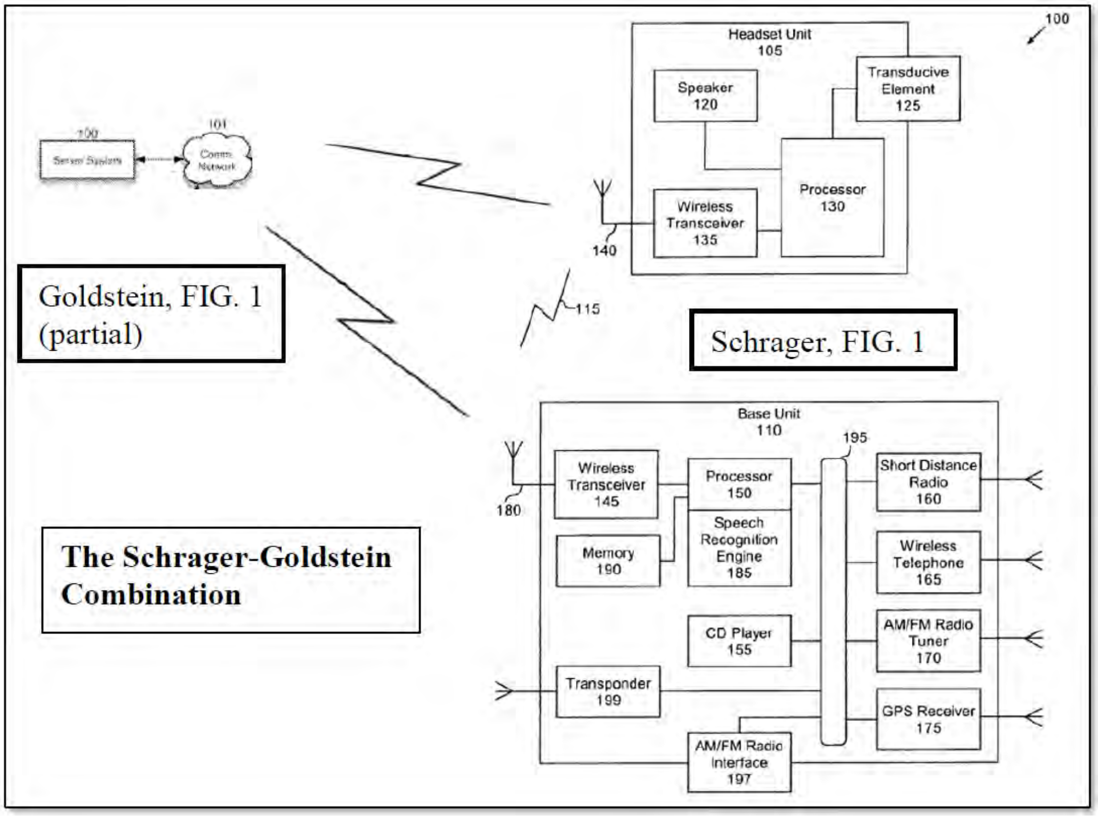
3. Independent Claim 1

Petitioner contends that the proposed combination of Schrager and Goldstein discloses the limitations of claim 1. Pet. 64–76. Patent Owner provides arguments addressing this asserted ground of unpatentability. PO Resp. 20–23.

a) The Combination of Schrager and Goldstein

Petitioner argues that one of ordinary skill in the art would have "had reason to add Goldstein's PAA software to Schrager's headset and base unit so that each communicated with Goldstein's remote server to (1) purchase/download/stream audio files, and (2) obtain firmware updates, per Goldstein." Pet. 60 (citing Ex. 1003 ¶ 340). First, Petitioner argues that Schrager's system is intended to play audio content such as music and "Goldstein provides a convenient way to control/stream/download/subscribe to/purchase music on a remote server offering a larger, updated content library compared to typical handheld devices." *Id.* at 61 (citing Ex. 1003 ¶ 341). Second, Petitioner argues that Goldstein teaches providing firmware updates to the headphone, and firmware updates had known benefits such as enhancing the headphone's functionality and security. *Id.* (citing Ex. 1026 ¶¶ 19, 82; Ex. 1003 ¶ 342). Third, Petitioner argues that the proposed combination would have yielded predictable results and would have improved Schrager's system by permitting the headset and base unit to obtain music and firmware from a remote server, as taught by Goldstein. *Id.* (citing Ex. 1003 ¶¶ 343–344).

Petitioner provides an illustration, reproduced below, intended to depict the system resulting from the proposed combination of Schrager and Goldstein.



Pet. 63. This illustration combines Figure 1 of Schrager on the right with a portion of Figure 1 of Goldstein (i.e., Goldstein's server system 100 and communication network 101) on the left, and shows Schrager's headset unit 105 and base unit 110 both to be in wireless communication with Goldstein's server system 100 and communication network 101.

Petitioner also contends that one of ordinary skill in the art would have a reasonable expectation of success in the combination because the proposed modification "would have been routine, requiring only ordinary skill as both [Schrager's headset and base unit] already include processors, memory, and wireless communication circuits suitable for storing/executing

Goldstein's PAA-software." Pet. 62 (citing Ex. 1003 ¶345; Ex. 1101, 5:5–8, 6:62–67, 7:24–28). Petitioner adds that Goldstein discloses that "the PAA software 'can be totally incorporated with . . . ***any portable technology*** which incorporates . . . protocols' like 'IEEE 802.11, Bluetooth,' and various cellular standards." *Id.* (quoting Ex. 1026 ¶ 113; Ex. 1003 ¶ 345).

Petitioner's proposed reasons to combine Schrager and Goldstein are realistic, have rational underpinning, and are supported by expert testimony, which we find persuasive and credit. Thus, Petitioner's evidence shows that a skilled artisan would have had reasons to combine the teachings of Schrager and Goldstein and would have had a reasonable expectation of success in doing so.

b) The Limitations of Claim 1

Petitioner contends that Schrager discloses that base unit 110 is a portable electronic device that includes CD player 155 or an MP3 player. Pet. 64–65 (citing Ex. 1101, 7:38–46; Ex. 1003 ¶ 350). Thus, Petitioner argues that the MP3 player is a digital audio player as claimed. *Id.* at 65 (citing Ex. 1101, 2:16–21, 7:38–44; Ex. 1003 ¶ 350). Petitioner also contends that Schrager's headset 105 is a headphone assembly that is separate from and in wireless communication with base unit 110, and, thus, the MP3 player. *Id.* at 66–67 (citing Ex. 1101, 2:46–48, 5:5–8; Ex. 1003 ¶¶ 352–354; Ex. 1005 ¶ 165). In addition, Petitioner contends that Schrager's headset 105 includes all of the components of the headphone assembly recited in claim 1. *Id.* at 67–72.

Regarding the claimed remote, network-connected server that is in wireless communication with the mobile, digital audio player, Petitioner contends that the combination of Schrager and Goldstein includes Goldstein's server system, "which is a 'remote, network-connected server'

because it is a separate device that communicates over a remote communication network 101 (*e.g.*, Internet)." *Id.* at 72 (citing Ex. 1026 ¶¶ 65, 76–78; Ex. 1003 ¶ 363).

Petitioner also argues that the Schrager's base unit 110 uses a Bluetooth connection (i.e., an ad hoc wireless communication link) to transmit digital audio content. *Id.* at 74 (citing Ex. 1101, 7:38–44; Ex. 1003 ¶ 367). In addition, Petitioner argues that, as taught by Goldstein, "another headphone assembly having Goldstein's PAA software (also a mobile DAP) transmits digital audio content (*e.g.*, stored MP3s) to Schrager-Goldstein's headphone assembly via an ad hoc (*e.g.*, Bluetooth) wireless communication link." *Id.* (citing Ex. 1026 ¶ 87; Ex. 1003 ¶ 368). Petitioner then asserts that this digital audio content that is playable by the headset's earphones. *Id.* at 75 (citing Ex. 1101, 5:11–14; . 1026 ¶ 78; Ex. 1003 ¶ 370; Ex. 1005 ¶¶ 165–166).

Last, Petitioner argues that the combination includes Schrager's control buttons that allow a user to initiate transmission of a request to the server. *Id.* at 75–76 (citing Ex. 1101, 5:31–6:18, 6:37–42; Ex. 1026 ¶¶ 78, 83–84, 100, 104, Figs. 1–2; Ex. 1003 ¶¶ 371–372; Ex. 1005 ¶ 177).

Based on Petitioner's evidence, including the testimony of Dr. Williams and Dr. Casali, we agree with Petitioner that, if Schrager and Goldstein are combined in the manner proposed by Petitioner, the combination teaches each limitation of claim 1.

c) Patent Owner's Arguments

Patent Owner argues that Goldstein discloses "connecting the Personal Audio Assistant to the Server ***or*** connecting the Personal Audio Assistant to other Personal Audio Assistants (peer-to-peer behavior)." PO Resp. 21–22 (quoting Ex. 1026 ¶ 76). Thus, according to Patent Owner,

"Goldstein teaches that Schrager's base unit, the purported DAP of claim 1, when equipped with Goldstein's PAA software, pursuant to Petitioner's theory, can connect to either the Server or to another PAA device (e.g., Schrager's headset)," but "could not connect simultaneously to both the server and to Schrager's headset as required by claim 1." *Id.* at 22 (citing Ex. 2024 ¶ 45). For similar reasons, Patent Owner also argues that "Schrager's headset, when equipped with Goldstein's PAA software, could not connect simultaneously to both the Server and to the Schrager's PAA-software-equipped base unit." *Id.* at 23 (citing Ex. 2024 ¶ 45).

Petitioner asserts that this argument misapprehends the Schrager-Goldstein combination and misreads Goldstein. Pet. Reply 9. Specifically, Petitioner argues that "in Schrager-Goldstein, the DAP (Schrager's base unit 110) connects to the combination's headphone (Schrager's headset unit 105) using ***Schrager's*** pre-existing 'wireless communication link 115,' and to Goldstein's Server using Goldstein's PAA software." *Id.* (citing Pet. 62–63, 68–73).

We find Petitioner's argument persuasive. Petitioner's illustration (reproduced above) that depicts the proposed combination of Schrager and Goldstein shows headset unit 105 and base unit 110 in communication via wireless communication link 115. *See* Pet. 63. The Petition states that, in the Schrager-Goldstein combination, the headset *continues* to communicate wirelessly with base unit 110 (*id.* at 62–63), thereby implying that headset unit 105 and base unit 110 maintain communication via wireless communication link 115. Furthermore, the Petition states that Schrager-Goldstein's headphone assembly includes an antenna that receives signals from base unit 110 over wireless communication link 115. *Id.* at 68–69.

In its Sur-reply, Patent Owner asserts that Petitioner's reply argument is misleading because its "original theory is that the purported DAP 'include[s] appropriately tailored versions of Goldstein's PAA software to communicate wirelessly with (i) Goldstein's Server System . . . and (ii) other headsets having Goldstein's PAA software.'" PO Sur-reply 9–10 (quoting Ex. 1003 ¶ 347; citing Pet. 62–63)[28] (alteration in original). This argument is not persuasive because the quoted language states that the headset and base unit of the combination each include Goldstein's PAA software to communicate wirelessly with the server and *other* headsets having Goldstein's PAA software. Ex. 1003 ¶ 347; *see also* Pet. 63. Neither the Petition nor Dr. Williams indicates that the headset of the combination uses Goldstein's PAA software to communicate wirelessly with the base unit. Ex. 1003 ¶ 347; Pet. 63.

In addition, as discussed above (*see supra* § II.E.4.c), Patent Owner's objective indicia of obviousness (evidence of commercial success) are entitled to little weight because Patent Owner has not shown a nexus between the claimed invention and the alleged commercial success.

d) Conclusion

For the foregoing reasons, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Schrager and Goldstein renders obvious claim 1.

4. Claims 40–43, 46, 48, and 51

Claim 40 depends from claim 1 and further recites that each of the earphones comprises "at least one acoustic transducer; a wireless

[28] Patent Owner actually cites to ¶ 327 of Exhibit 1003, but the quoted language appears in ¶ 347.

communication circuit; a body portion that sits at least partially in an ear of the user when the headphone assembly is worn by the user; and an elongated portion that extends from the body portion." Ex. 1001, 23:1–8. Claims 42, 43, 46, 48, and 51 depend from claim 40.

Regarding the limitations of claim 40, Petitioner argues that the earphones in the Schrager-Goldstein combination each comprise at least one acoustic transducer to provide stereo audio sound. Pet. 82 (citing Ex. 1101, 5:11–14; Ex. 1003 ¶ 404; Ex. 1005 ¶¶ 165–166). Petitioner also argues that the combination uses Goldstein's form-factors including an "intra-aural" design in which each earpiece has a wireless communication circuit. *Id.* (citing Ex. 1026 ¶¶ 48, 66, Fig. 2). Petitioner contends that "as illustrated in Goldstein's Figure 5A, each earbud has 'a body portion that sits at least partially in an ear of the user when the headphone assembly is worn by the user,' as claimed." *Id.* at 82–83 (citing Ex. 1026, Fig. 5A; Ex. 1005 ¶¶ 182–183). According to Petitioner, because Goldstein's intra-aural designs include a behind-the-ear ("BTE") implementation, one of ordinary skill in the art would have understood this to include the claimed "elongated portion." *Id.* at 83 (citing Ex. 1026 ¶ 43; Ex. 1005 ¶ 183; Ex. 1003 ¶¶ 406–407).

Patent Owner argues that "even assuming that a BTE implementation includes an elongated portion, Petitioner does not explain that the BTE implementation would even have the 'body portion' of the claim 40, much less that the allegedly 'elongated portion' would extend from the 'body portion.'" PO Resp. 51. Patent Owner adds that Goldstein's description of Figure 5A does not mention a BTE implementation and it is hindsight to say one of ordinary skill in the art would have been motivated to add a BTE

hanger bar to the in-the-canal ("ITC") earphone of Figure 5A. *Id.* at 51–52 (citing Ex. 1026 ¶ 69).

We agree with Patent Owner. Although ¶ 43 of Goldstein does disclose that "an intra-aural device" could comprise a BTE form factor, Petitioner fails to explain sufficiently why this disclosure would have caused one of ordinary skill in the art to understand earpiece 500 in Figure 5A to include the claimed "elongated portion." What the Petition actually proposes requires taking elements from two different form-factors: the ITC earpiece of Figure 5A and the BTE device mentioned in ¶ 43. The problem is that Petitioner fails to adequately explain why or how one of ordinary skill in the art would modify earpiece 500 to include a hanger bar. Hanger bars may have been conventional, as Petitioner and Dr. Casali assert, but we find that Petitioner has not articulated a reason, with rational underpinning, for modifying earpiece 500 to include a hanger bar or any other elongated portion.

In its Reply, Petitioner contends it "argued that POSAs knew how to add a ***conventional*** earhook to Goldstein's Figure 5A earbud, and that such an earhook would have included claim 40's 'elongated portion.'" Pet. Reply 30 (citing Pet. 83). We disagree that the Petition asserts *adding* a conventional earhook to the ITC earpiece of Figure 5A. Instead, the Petition states only that persons having ordinary skill in the art understood that a BTE implementation "includes, or conventionally included," an elongated portion extending from the body portion. Pet. 83. In any event, as discussed above, Petitioner does not articulate an adequate rationale for adding an earhook to the ITC earpiece of Figure 5A.

For the foregoing reasons, we determine that Petitioner has not shown by a preponderance of the evidence that the combination of Schrager and

Goldstein renders obvious claim 40 or claims 41–43, 46, 48, and 51 depending therefrom.

5. Claims 2, 3, 6, 8, 10–13, 16, 18, 38, 39, 52, 54, and 56

Petitioner provides reasonable and detailed explanations, supported by the testimony of Dr. Williams and Dr. Casali, indicating where in the references the limitations of claims 2, 3, 6, 8, 10–13, 16, 18, 38, 39, 52, 54, and 56 are disclosed by Schrager and Goldstein. Pet. 76–81, 84. Other than its contentions regarding objective indicia of non-obviousness (entitled to little weight, as discussed above), Patent Owner offers no particular arguments with respect to these dependent claims.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that the combination of Schrager and Goldstein renders obvious claims 2, 3, 6, 8, 10–13, 16, 18, 38, 39, 52, 54, and 56 for the reasons discussed in the Petition and as supported by the testimony of Dr. Williams and Dr. Casali.

N. Ground 2B, 2D, and 2F: Signal Strength Claims

Petitioner challenges claims 4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28, 44, 45, 47, 49, and 50 as unpatentable under 35 U.S.C. § 103(a) based on Schrager, Goldstein, and Harada; claims 32, 33, 35, and 37 as unpatentable under 35 U.S.C. § 103(a) based on Schrager, Goldstein, Davis, and Harada; and claims 23, 24, 26, and 28 as unpatentable under 35 U.S.C. § 103(a) based on Schrager, Goldstein, Skulley, and Harada. Pet. 84–86, 88–89, 91. All of these claims are Signal Strength claims. For these grounds, Petitioner relies on the teachings of Harada in the same manner as the teachings were relied on in Ground 1B. *See id.* at 85, 88, 91. During the trial, both parties relied on the same Signal Strength arguments for all grounds challenging

Signal Strength claims. *See* PO Resp. 32–40; Pet. Reply 16–20; PO Sur-reply 10–14. As discussed above, we determine that Harada does not teach that it would have been obvious to implement a headphone assembly to transition from one digital audio source to another based on a signal strength. *See supra* § II.F.2. For the same reasons we find that Harada does not supply the limitation missing from Schrager and Goldstein and Petitioner has not articulated a reason, with rational underpinning, to combine Schrager and Goldstein with Harada. Accordingly, we determine that Petitioner has not proved, by a preponderance of the evidence, that claims 4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28, 44, 45, 47, 49, and 50 would have been obvious over Schrager, Goldstein, and Harada, that claims 32, 33, 35, and 37 would have been obvious over Schrager, Goldstein, Davis, and Harada, or that claims 23, 24, 26, and 28 would have been obvious over Schrager, Goldstein, Skulley, and Harada.

O. Ground 2C: Asserted Obviousness Based on Schrager, Goldstein, and Davis

Petitioner challenges claims 29–31, 34, 36, 53, and 55 as unpatentable under 35 U.S.C. § 103(a) based on Schrager, Goldstein, and Davis.[29] Pet. 87–88. For this ground, Petitioner relies on the teachings of Davis in the same manner as the teachings were relied on in Ground 1D. *See id.* at 87.

Patent Owner relies on the same arguments addressed above in connection with Ground 1D. *See* PO Resp. 53–56; PO Sur-reply 20–21. For

[29] Although listed in the heading for this ground on page 87 of the Petition, claim 51 is not addressed in this ground. Pet. 87–88. Accordingly, we do not include it in our analysis.

the reasons addressed above, these arguments are unavailing, and we find Petitioner's showing persuasive. *See supra* § II.H.2.

Accordingly, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Schrager, Goldstein, and Davis renders obvious claims 29–31, 34, 36, 53, and 55.

P. Ground 2E: Asserted Obviousness Based on Schrager, Goldstein, and Skulley

Petitioner challenges claims 20–22, 25, 27, 39, and 54–56 as unpatentable under 35 U.S.C. § 103(a) based on Schrager, Goldstein, and Skulley. Pet. 89–91.

Other than its contentions regarding objective indicia of non-obviousness (entitled to little weight, as discussed above), Patent Owner does not offer any arguments specifically addressing this challenge to claims 20–22, 25, 27, 39, and 54–56. *See generally* PO Resp. We need not set forth formal findings as to the undisputed assertions by Petitioner that claims 20–22, 25, 27, 39, and 54–56 would have been obvious in view of the combination of Schrager, Goldstein, and Skulley. *See LG Elecs.*, 759 F. App'x at 925; *see also* Paper 16, 8 (cautioning Patent Owner "that any arguments not raised in the response may be deemed waived"). Nevertheless, we have reviewed Petitioner's contentions for this ground and determine that Petitioner has shown by a preponderance of the evidence that the combination of Schrager, Goldstein, and Skulley renders obvious claims 20–22, 25, 27, 39, and 54–56.

III. CONCLUSION[30]

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–3, 6, 8, 11–13, 16, 18, 20–22, 25, 27, 39, 52, 54–56	103(a)	Rezvani-446, Rezvani-875, Skulley	1–3, 6, 8, 11–13, 16, 18, 20–22, 25, 27, 39, 52, 54–56	
4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28	103(a)	Rezvani-446, Rezvani-875, Skulley, Harada		4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28
10, 38	103(a)	Rezvani-446, Rezvani-875, Skulley, Hind	10, 38	
29–31, 34, 36, 53	103(a)	Rezvani-446, Rezvani-875, Skulley, Davis	29–31, 34, 36, 53	
32, 33, 35, 37	103(a)	Rezvani-446, Rezvani-875, Skulley, Davis, Harada		32, 33, 35, 37

[30] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

40–43, 46, 48	103(a)	Rezvani-446, Rezvani-875, Skulley, Davis, Oh	40–43, 46, 48	
44, 45, 47, 49, 50	103(a)	Rezvani-446, Rezvani-875, Skulley, Davis, Oh, Harada		44, 45, 47, 49, 50
51	103(a)	Rezvani-446, Rezvani-875, Skulley, Davis, Oh, Hind	51	
1–3, 6, 8, 10–13, 16, 18, 38–43, 46, 48, 51, 52, 54, 56	103(a)	Schrager, Goldstein	1, 2, 3, 6, 8, 10–13, 16, 18, 38, 39, 52, 54, 56	40–43, 46, 48, 51
4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28, 44, 45, 47, 49, 50	103(a)	Schrager, Goldstein, Harada		4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28, 44, 45, 47, 49, 50
29–31, 34, 36, 53, 55	103(a)	Schrager, Goldstein, Davis	29–31, 34, 36, 53, 55	
32, 33, 35, 37	103(a)	Schrager, Goldstein, Davis, Harada		32, 33, 35, 37
20–22, 25, 27, 39, 54–56	103(a)	Schrager, Goldstein, Skulley	20–22, 25, 27, 39, 54–56	
23, 24, 26, 28	103(a)	Schrager, Goldstein, Skulley, Harada		23, 24, 26, 28

Overall Outcome			1–3, 6, 8, 10–13, 16, 18, 20–22, 25, 27, 29–31, 34, 36, 38–43, 46, 48, 51–56	4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28, 32, 33, 35, 37, 44, 45, 47, 49, 50

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–3, 6, 8, 10–13, 16, 18, 20–22, 25, 27, 29–31, 34, 36, 38–43, 46, 48, and 51–56 of U.S. Patent No. 10,206,025 B2 are determined to be unpatentable;

FURTHER ORDERED that claims 4, 5, 7, 9, 14, 15, 17, 19, 23, 24, 26, 28, 32, 33, 35, 37, 44, 45, 47, 49, and 50 of U.S. Patent No. 10,206,025 B2 are not determined to be unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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US010469934B2

(12) **United States Patent**
Koss et al.

(10) **Patent No.: US 10,469,934 B2**
(45) **Date of Patent: *Nov. 5, 2019**

(54) **SYSTEM WITH WIRELESS EARPHONES**

(71) Applicant: **Koss Corporation**, Milwaukee, WI (US)

(72) Inventors: **Michael J. Koss**, Milwaukee, WI (US); **Michael J. Pelland**, Princeton, WI (US); **Michael Sagan**, Fairfield, CA (US); **Steven R. Reckamp**, Crystal Lake, IL (US); **Gregory J. Hallingstad**, Deforest, WI (US); **Jeffery K. Bovee**, Sterling, IL (US); **Morgan J. Lowery**, Deforest, WI (US)

(73) Assignee: **KOSS CORPORATION**, Milwaukee, WI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **16/375,879**

(22) Filed: **Apr. 5, 2019**

(65) **Prior Publication Data**

US 2019/0238970 A1 Aug. 1, 2019

Related U.S. Application Data

(63) Continuation of application No. 16/182,927, filed on Nov. 7, 2018, which is a continuation of application (Continued)

(51) **Int. Cl.**

H04R 1/10	(2006.01)
H04M 1/02	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC .... ***H04R 1/1041*** (2013.01); ***H03G 3/02*** (2013.01); ***H03K 17/9622*** (2013.01); (Continued)

(58) **Field of Classification Search**

CPC H04R 2201/107; H04R 3/00

(Continued)

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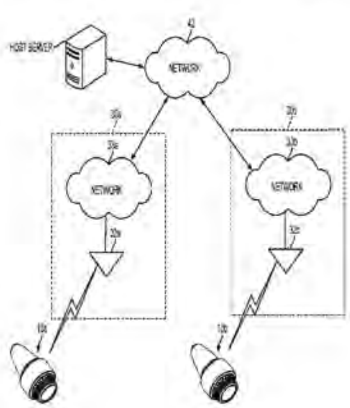
Primary Examiner — Kiet M Doan

(74) *Attorney, Agent, or Firm* — K&L Gates LLP

(57) **ABSTRACT**

Apparatus comprises adapter and speaker system. Adapter is configured to plug into port of personal digital audio player. Speaker system is in communication with adapter, and comprises multiple acoustic transducers, programmable processor circuit, and wireless communication circuit. In first operational mode, processor circuit receives, via adapter, and processes digital audio content from personal digital audio player into which adapter is plugged, and the multiple acoustic transducers output the received audio content from the personal digital audio player. In second operational mode, wireless communication circuit receives digital audio content from a remote digital audio source over a wireless network, processor circuit processes the digital audio content received from remote digital audio source, and the multiple acoustic transducers output the audio content received from the remote digital audio source.

62 Claims, 16 Drawing Sheets



Related U.S. Application Data

No. 15/962,305, filed on Apr. 25, 2018, now Pat. No. 10,206,025, which is a continuation of application No. 15/650,362, filed on Jul. 14, 2017, now Pat. No. 9,986,325, which is a continuation of application No. 15/293,785, filed on Oct. 14, 2016, now Pat. No. 9,729,959, which is a continuation of application No. 15/082,040, filed on Mar. 28, 2016, now Pat. No. 9,497,535, which is a continuation of application No. 14/695,696, filed on Apr. 24, 2015, now Pat. No. 9,438,987, which is a continuation of application No. 13/609,409, filed on Sep. 11, 2012, now Pat. No. 9,049,502, which is a continuation of application No. 13/459,291, filed on Apr. 30, 2012, now Pat. No. 8,571,544, which is a continuation of application No. 12/936,488, filed as application No. PCT/US2009/039754 on Apr. 7, 2009, now Pat. No. 8,190,203.

(60) Provisional application No. 61/123,265, filed on Apr. 7, 2008.

(51) **Int. Cl.**

H04R 5/033 (2006.01)
H04R 5/04 (2006.01)
H03K 17/96 (2006.01)
H04W 4/80 (2018.01)
H04R 3/00 (2006.01)
H04W 48/20 (2009.01)
H03G 3/02 (2006.01)
H04R 1/02 (2006.01)
H04H 20/95 (2008.01)
H04L 29/12 (2006.01)
H04R 25/00 (2006.01)
H04W 84/18 (2009.01)
H04W 84/12 (2009.01)

(52) **U.S. Cl.**

CPC ***H04H 20/95*** (2013.01); ***H04L 61/6068*** (2013.01); ***H04M 1/0254*** (2013.01); ***H04R 1/02*** (2013.01); ***H04R 1/1091*** (2013.01); ***H04R 3/00*** (2013.01); ***H04R 5/033*** (2013.01); ***H04R 5/04*** (2013.01); ***H04W 4/80*** (2018.02); ***H04W 48/20*** (2013.01); *H03K 2217/960785* (2013.01); *H04R 25/554* (2013.01); *H04R 2201/103* (2013.01); *H04R 2201/107* (2013.01); *H04R 2225/55* (2013.01); *H04R 2420/07* (2013.01); *H04W 84/12* (2013.01); *H04W 84/18* (2013.01)

(58) **Field of Classification Search**

USPC 455/466, 41.2, 556.1, 421, 569.1, 575.2, 455/553.1; 381/58, 312, 309, 74; 700/94

See application file for complete search history.

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IT Review, "LTB 802.11 WiFi Headphones", http://itreview.belproject.com/item/1536 accessed on Mar. 13, 2008 (4 pages).

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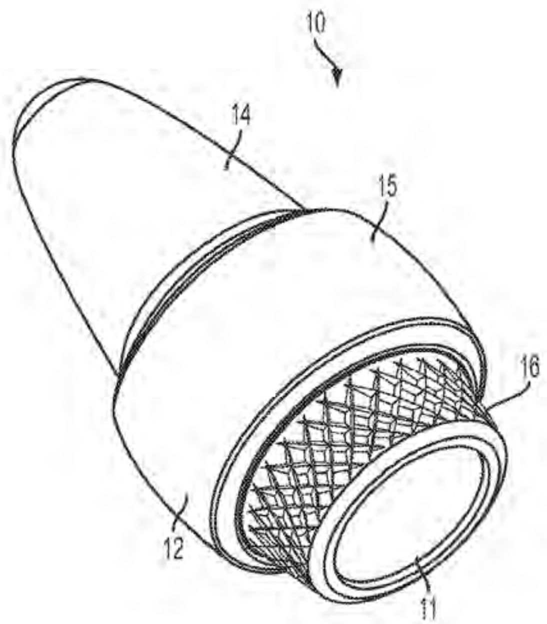


FIG. 1A

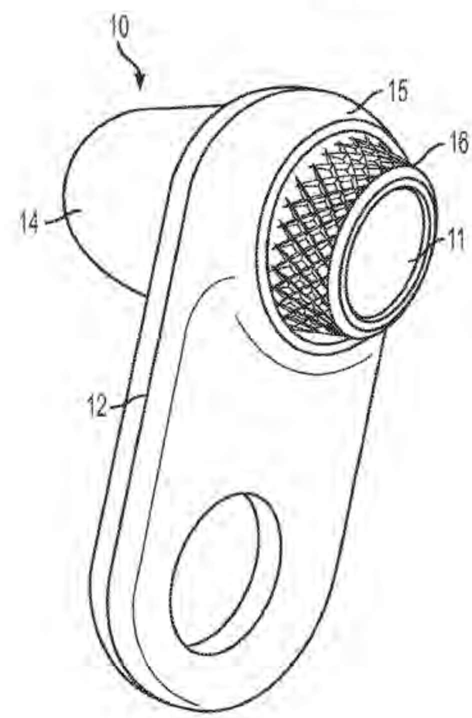


FIG. 1B

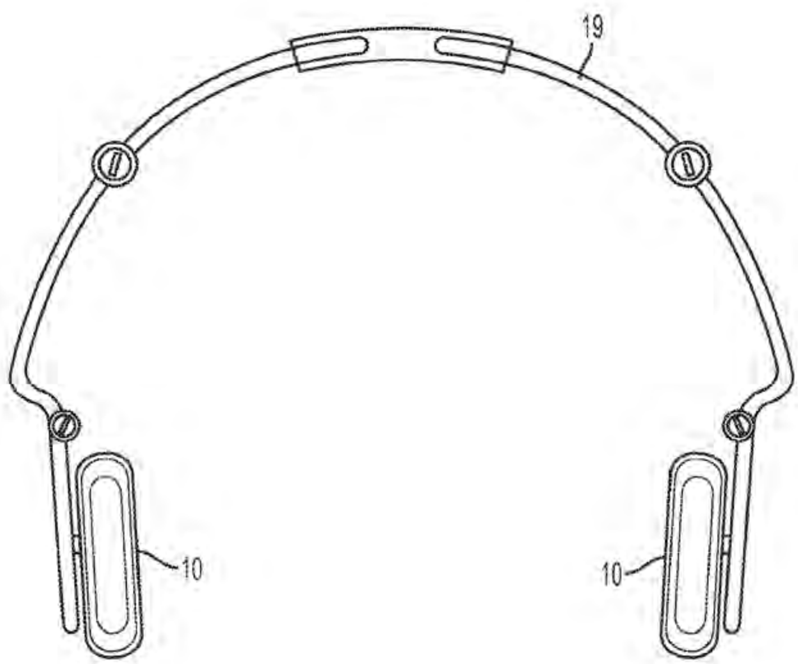


FIG. 1C

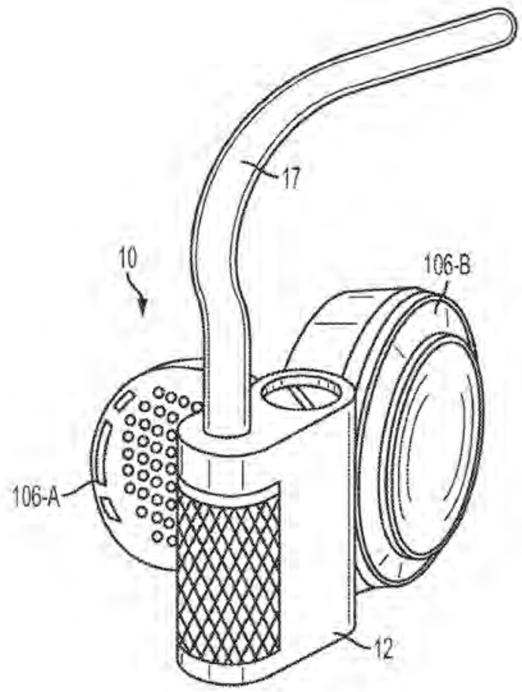


FIG. 1D

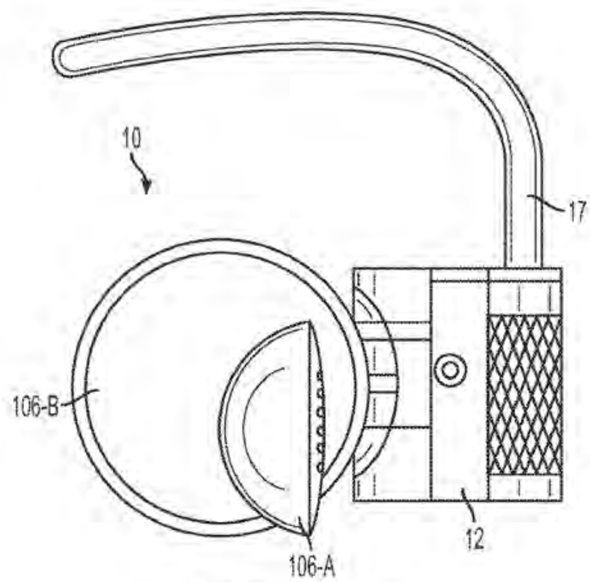


FIG. 1E

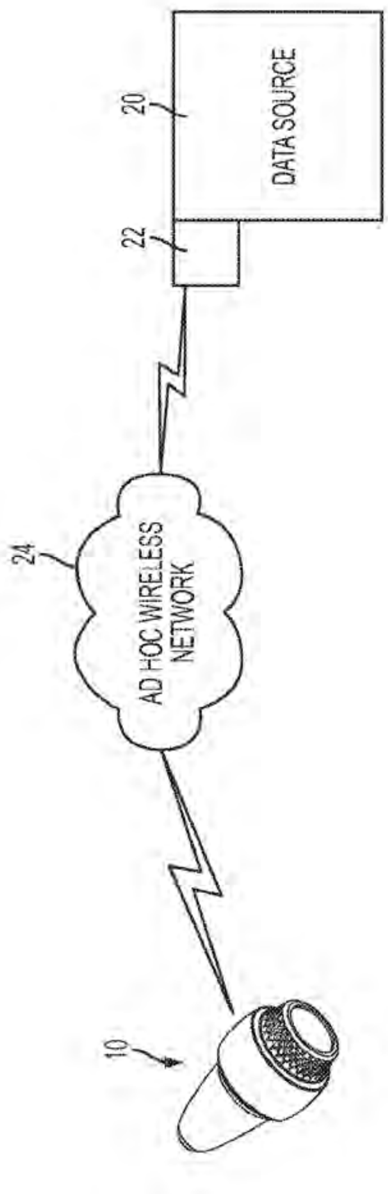


FIG. 2A

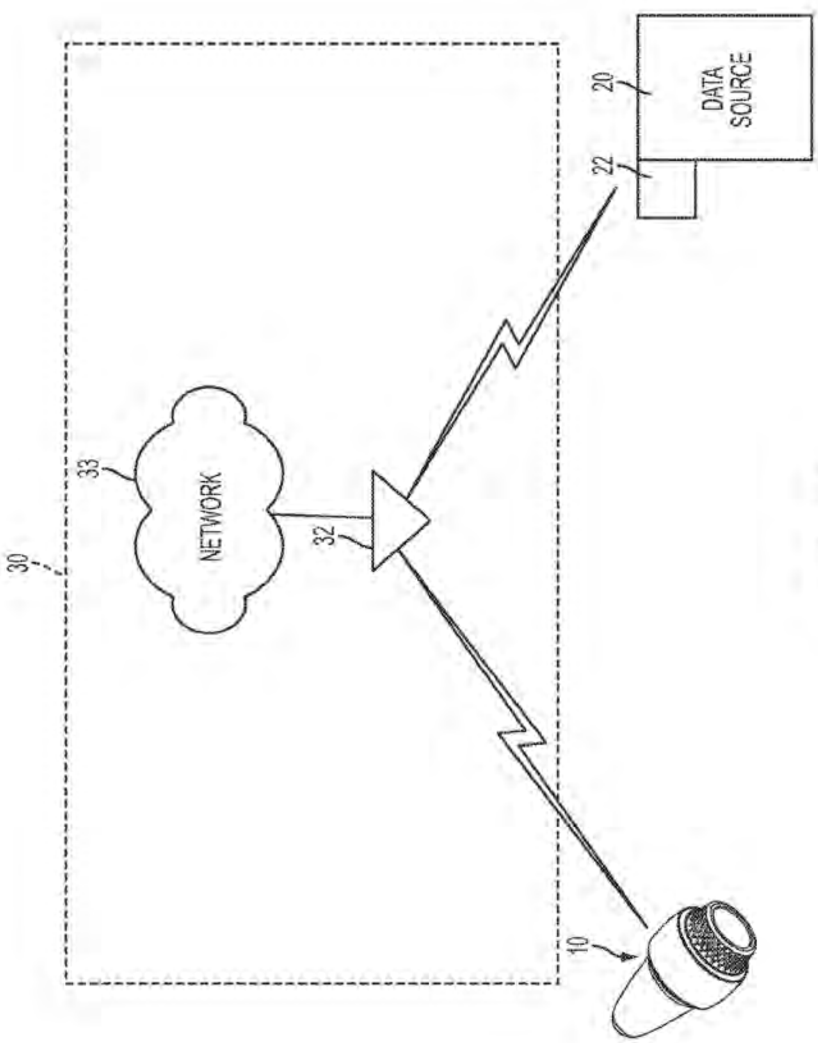


FIG. 2B

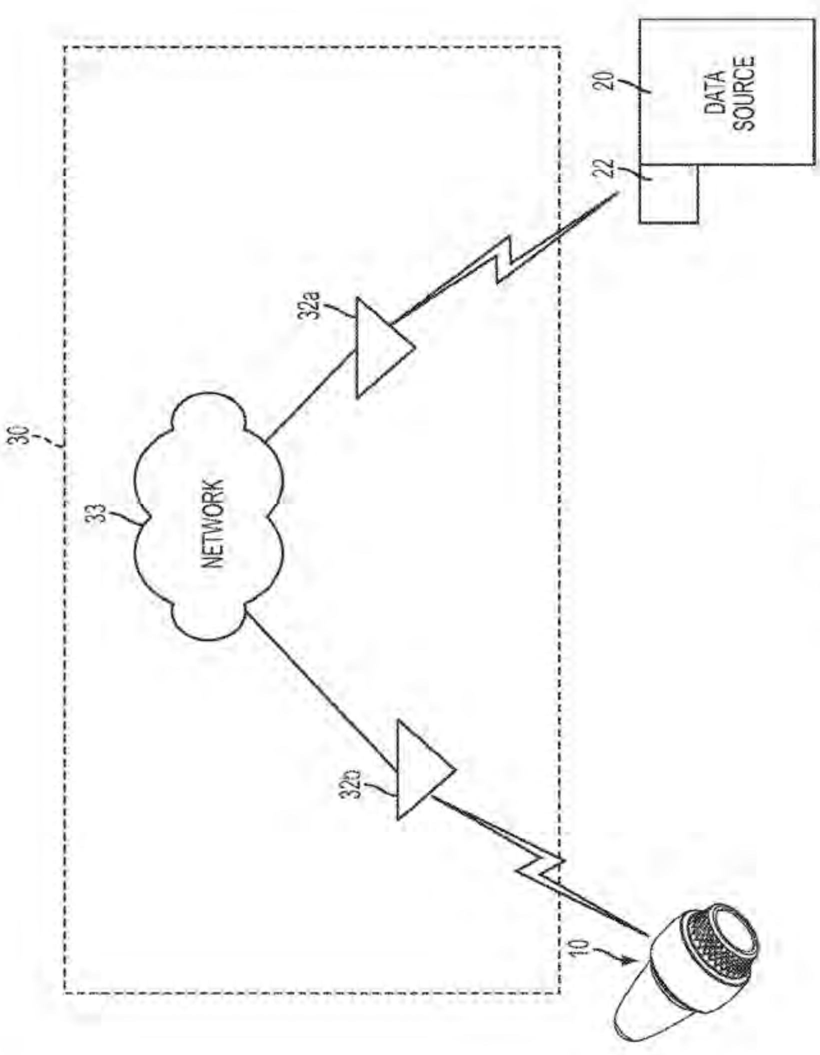


FIG. 2C

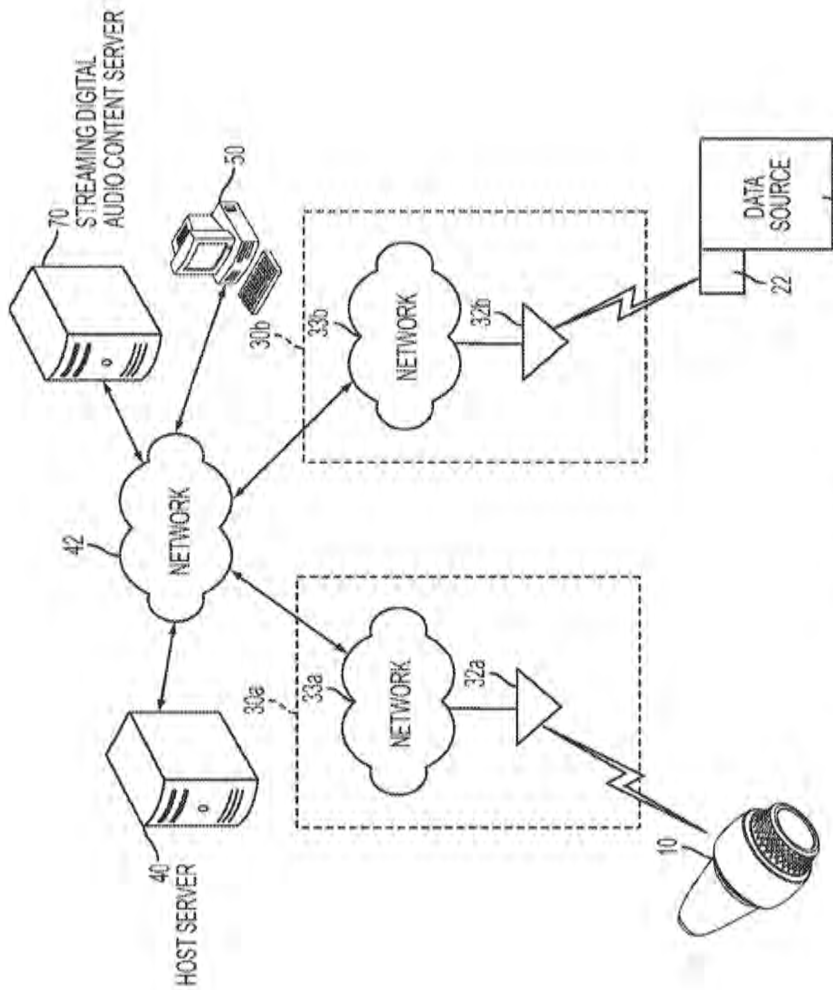

70
STREAMING DIGITAL
AUDIO CONTENT SERVER
50
42
NETWORK
30b
33b
NETWORK
32b
DATA
SOURCE
20
22
40
HOST SERVER
30a
33a
NETWORK
32a
10

FIG. 2D

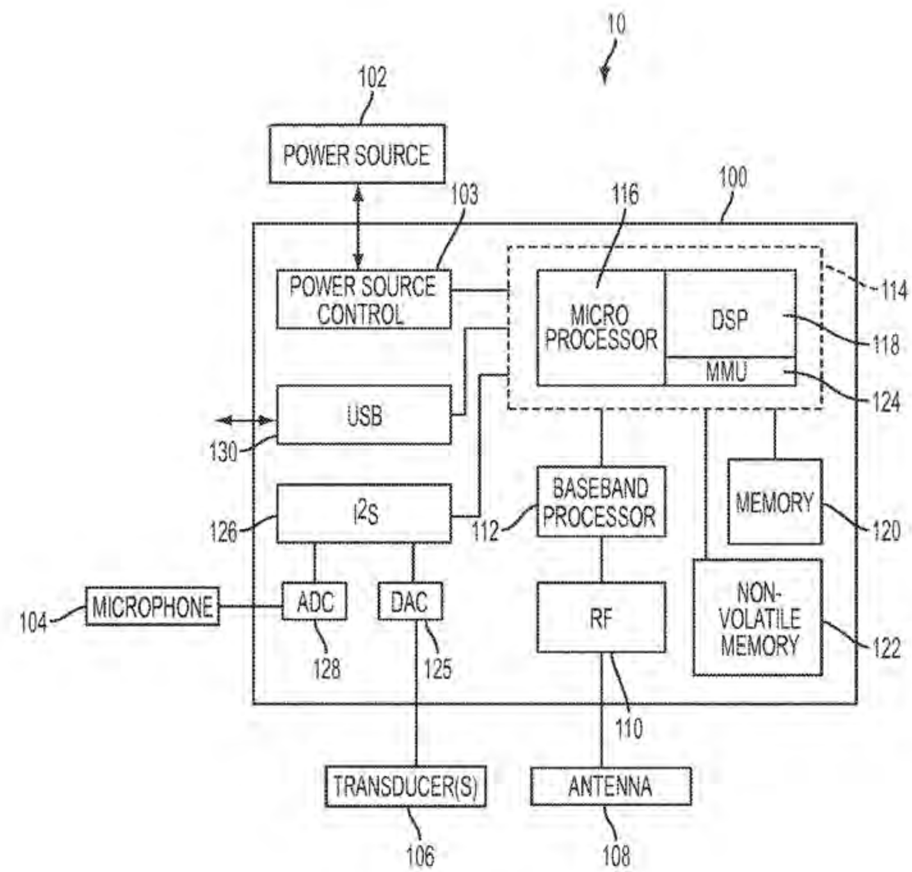

10
102
POWER SOURCE
103
116
100
POWER SOURCE CONTROL
MICRO PROCESSOR
DSP
MMU
114
118
124
USB
130
I2S
126
112
BASEBAND PROCESSOR
MEMORY
120
104
MICROPHONE
ADC
DAC
RF
NON-VOLATILE MEMORY
122
128
125
110
TRANSDUCER(S)
ANTENNA
106
108

FIG. 3

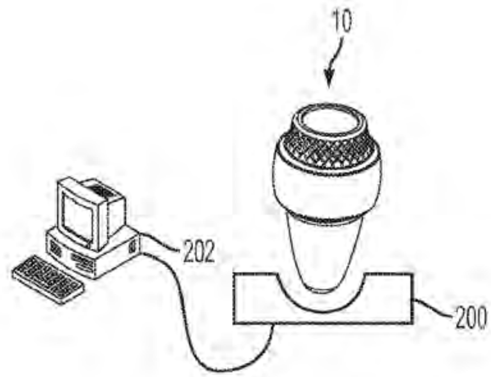


FIG. 4A

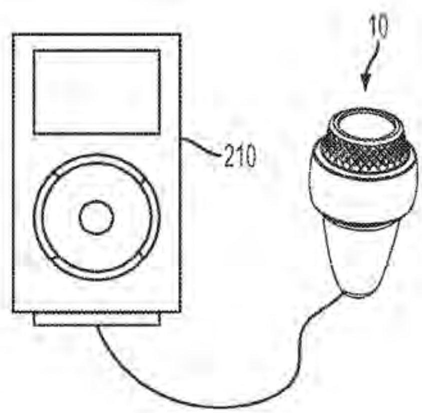


FIG. 4B

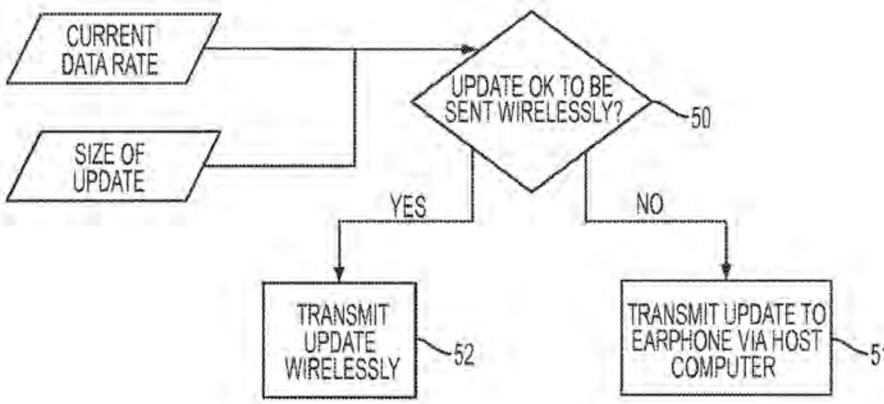
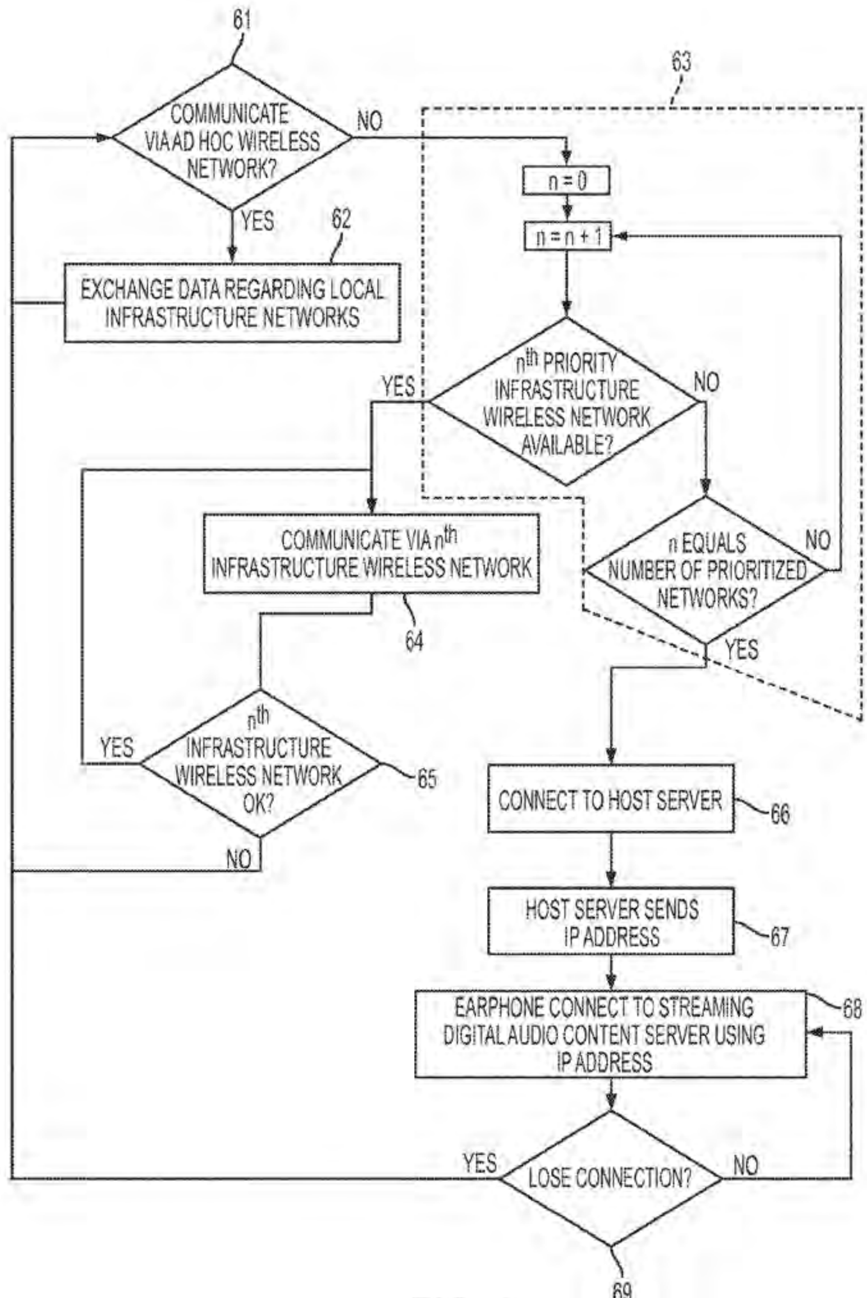

CURRENT DATA RATE
SIZE OF UPDATE
UPDATE OK TO BE SENT WIRELESSLY?
50
YES
NO
TRANSMIT UPDATE WIRELESSLY
52
TRANSMIT UPDATE TO EARPHONE VIA HOST COMPUTER
51

FIG. 5



61
COMMUNICATE VIA AD HOC WIRELESS NETWORK?
NO
YES
62
EXCHANGE DATA REGARDING LOCAL INFRASTRUCTURE NETWORKS
63
n = 0
n = n + 1
nth PRIORITY INFRASTRUCTURE WIRELESS NETWORK AVAILABLE?
YES
NO
COMMUNICATE VIA nth INFRASTRUCTURE WIRELESS NETWORK
64
n EQUALS NUMBER OF PRIORITIZED NETWORKS?
NO
YES
nth INFRASTRUCTURE WIRELESS NETWORK OK?
YES
NO
65
CONNECT TO HOST SERVER
66
HOST SERVER SENDS IP ADDRESS
67
EARPHONE CONNECT TO STREAMING DIGITAL AUDIO CONTENT SERVER USING IP ADDRESS
68
LOSE CONNECTION?
YES
NO
69

FIG. 6

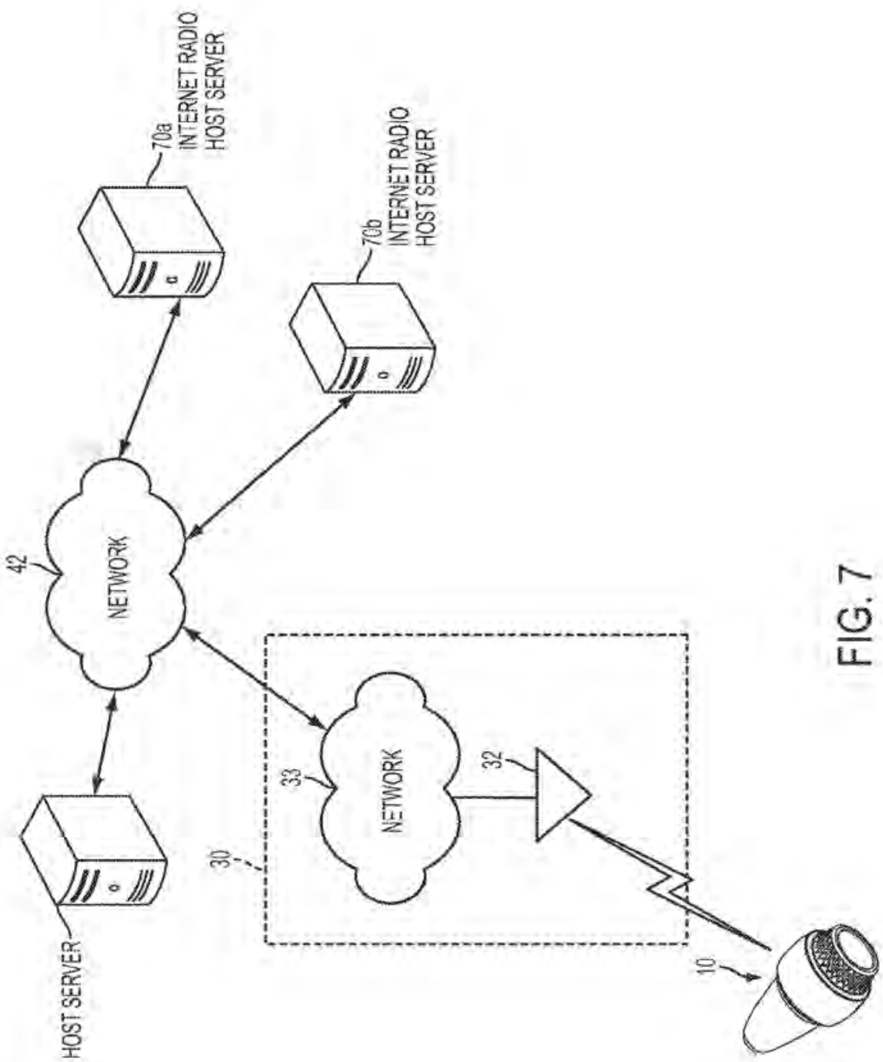

70a
INTERNET RADIO
HOST SERVER
70b
INTERNET RADIO
HOST SERVER
42
NETWORK
33
NETWORK
32
30
10
HOST SERVER

FIG. 7

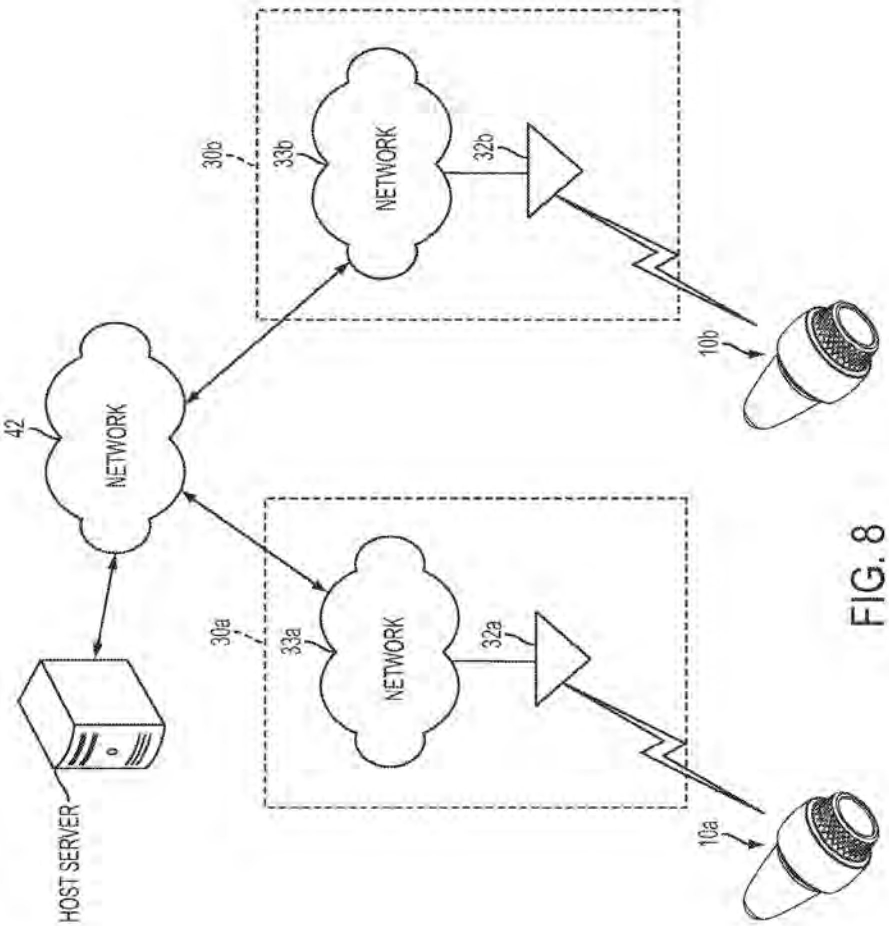

30b
33b
NETWORK
32b
10b
42
NETWORK
30a
33a
NETWORK
32a
10a
HOST SERVER

FIG. 8

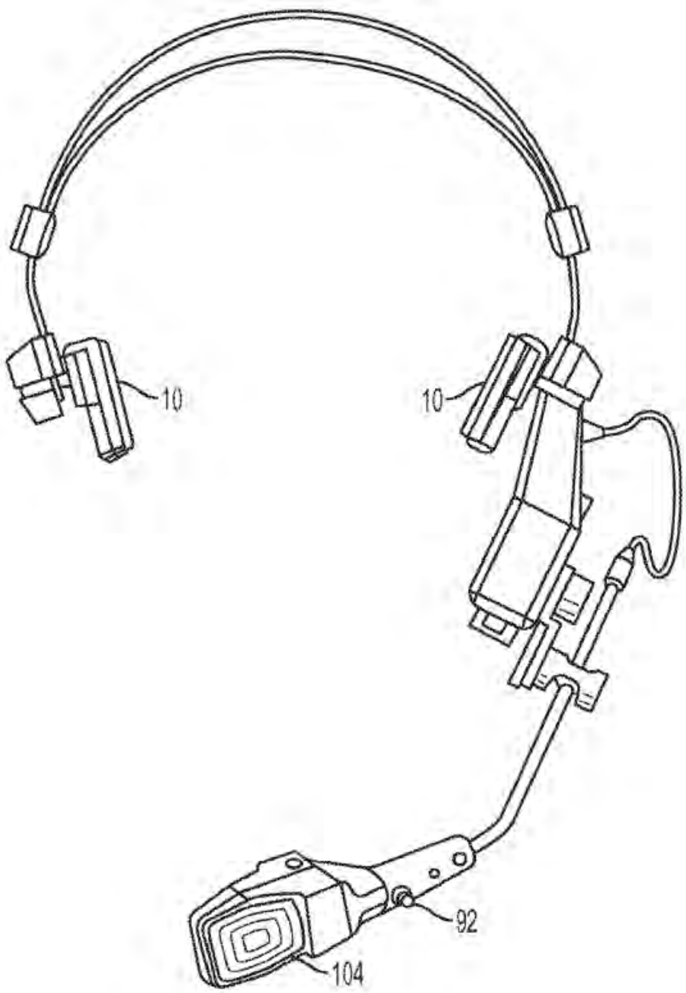


FIG. 9

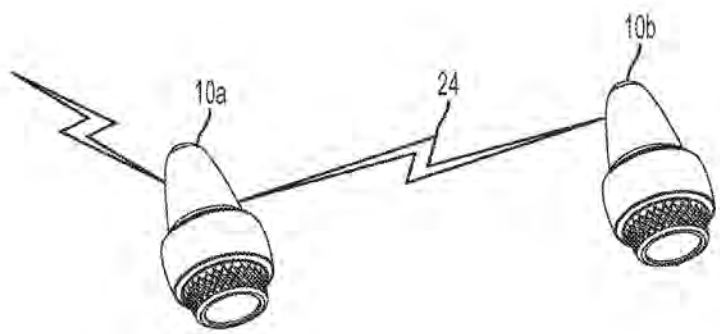


FIG. 10

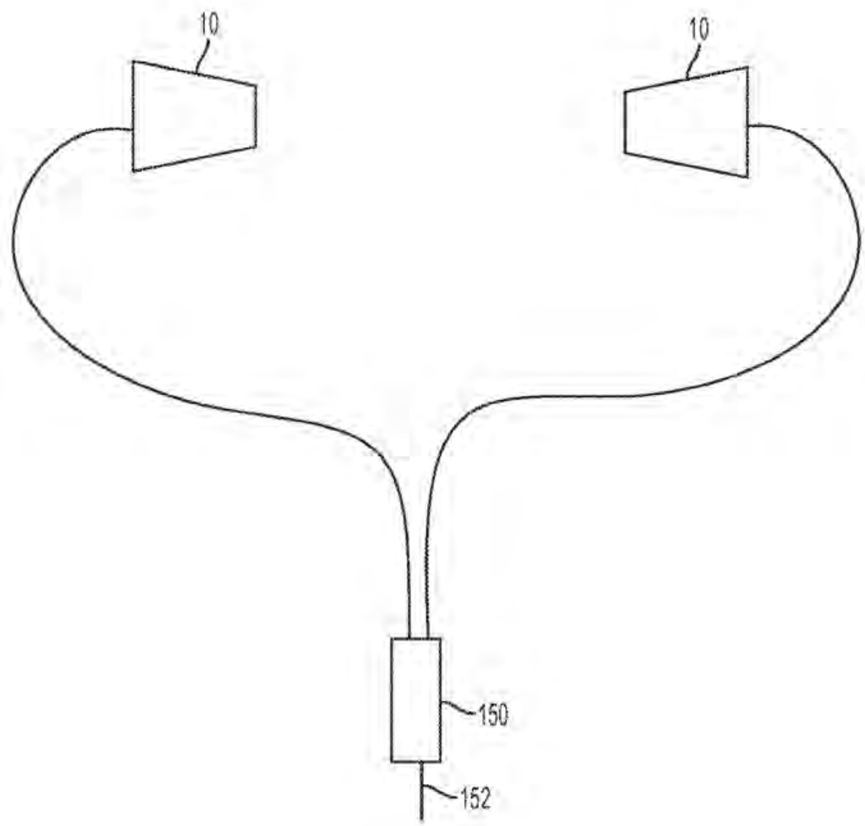


FIG. 11

SYSTEM WITH WIRELESS EARPHONES

PRIORITY CLAIM

The present application claims priority as a continuation to U.S. nonprovisional patent application Ser. No. 16/182,927, filed Nov. 7, 2018, which is a continuation of U.S. nonprovisional patent application Ser. No. 15/962,305, filed Apr. 25, 2018, now U.S. Pat. No. 10,206,025, which is a continuation of U.S. nonprovisional patent application Ser. No. 15/650,362, filed Jul. 14, 2017, now U.S. Pat. No. 9,986,325, issued May 29, 2018, which is a continuation of U.S. nonprovisional patent application Ser. No. 15/293,785, filed Oct. 14, 2016, now U.S. Pat. No. 9,729,959, issued Aug. 8, 2017, which is a continuation of U.S. nonprovisional patent application Ser. No. 15/082,040, filed Mar. 28, 2016, now U.S. Pat. No. 9,497,535, issued Nov. 15, 2016, which is a continuation of U.S. nonprovisional patent application Ser. No. 14/695,696, filed Apr. 24, 2015, now U.S. Pat. No. 9,438,987, issued on Sep. 6, 2016, which is a continuation of U.S. nonprovisional patent application Ser. No. 13/609,409, filed Sep. 11, 2012, now U.S. Pat. No. 9,049,502, issued Jun. 2, 2015, which is a continuation of U.S. nonprovisional patent application Ser. No. 13/459,291, filed Apr. 30, 2012, now U.S. Pat. No. 8,571,544, issued Oct. 29, 2013, which is a continuation of U.S. patent application Ser. No. 12/936,488, filed Dec. 20, 2010, now U.S. Pat. No. 8,190,203, issued May 29, 2012, which is a national stage entry of PCT/US2009/039754, filed Apr. 7, 2009, which claims priority to U.S. provisional patent application Ser. No. 61/123,265, filed Apr. 7, 2008, all of which are incorporated herein by reference in their entireties.

CROSS-REFERENCE TO RELATED APPLICATIONS

U.S. nonprovisional patent application Ser. No. 14/031,938, filed Sep. 13, 2013, now U.S. Pat. No. 8,655,420, issued Feb. 18, 2014, is also a continuation of U.S. nonprovisional patent application Ser. No. 13/609,409, filed Sep. 11, 2012, now U.S. Pat. No. 9,049,502, mentioned above.

BACKGROUND

Digital audio players, such as MP3 players and iPods, that store and play digital audio files, are very popular. Such devices typically comprise a data storage unit for storing and playing the digital audio, and a headphone set that connects to the data storage unit, usually with a ¼" or a 3.5 mm jack and associated cord. Often the headphones are in-ear type headphones. The cord, however, between the headphones and the data storage unit can be cumbersome and annoying to users, and the length of the cord limits the physical distance between the data storage unit and the headphones. Accordingly, some cordless headphones have been proposed, such as the Monster iFreePlay cordless headphones from Apple Inc., which include a docking port on one of the earphones that can connect directly to an iPod Shuffle. Because they have the docking port, however, the Monster iFreePlay cordless headphones from Apple are quite large and are not in-ear type phones. Recently, cordless headphones that connect wirelessly via IEEE 802.11 to a WLAN-ready laptop or personal computer (PC) have been proposed, but such headphones are also quite large and not in-ear type phones.

SUMMARY

In one general aspect, the present invention is directed to a wireless earphone that comprises a transceiver circuit for receiving streaming audio from a data source, such as a digital audio player or a computer, over an ad hoc wireless network. When the data source and the earphone are out of range via the ad hoc wireless network, they may transition automatically to a common infrastructure wireless network (e.g., a wireless LAN). If there is no common infrastructure wireless network for both the data source and the earphone, the earphone may connect via an available infrastructure wireless network to a host server. The host server may, for example, broadcast streaming audio to the earphone and/or transmit to the earphone a network address (e.g., an Internet Protocol (IP) address) for a network-connected content server that streams digital audio. The earphone may then connect to the content server using the IP address. The content server may be an Internet radio server, including, for example, an Internet radio server that broadcasts streaming audio from the data source or some other content.

These and other advantageous, unique aspects of the wireless earphone are described below.

FIGURES

Various embodiments of the present invention are described herein by way of example in conjunction with the following figures, wherein:

FIGS. **1A-1E** are views of a wireless earphone according to various embodiments of the present invention;

FIGS. **2A-2D** illustrate various communication modes for a wireless earphone according to various embodiments of the present invention;

FIG. **3** is a block diagram of a wireless earphone according to various embodiments of the present invention;

FIGS. **4A-4B** show the wireless earphone connected to another device according to various embodiments of the present invention;

FIG. **5** is a diagram of a process implemented by a host server according to various embodiments of the present invention;

FIG. **6** is a diagram of a process implemented by the wireless earphone to transition automatically between wireless networks according to various embodiments of the present invention;

FIGS. **7**, **8** and **10** illustrate communication systems involving the wireless earphone according to various embodiments of the present invention;

FIG. **9** is a diagram of a headset including a wireless earphone and a microphone according to various embodiments of the present invention; and

FIG. **11** is a diagram of a pair of wireless earphones with a dongle according to various embodiments of the present invention.

DESCRIPTION

In one general aspect, the present invention is directed to a wireless earphone that receives streaming audio data via ad hoc wireless networks and infrastructure wireless networks, and that transitions seamlessly between wireless networks. The earphone may comprise one or more in-ear, on-ear, or over-ear speaker elements. Two exemplary in-ear earphone shapes for the wireless earphone **10** are shown in FIGS. **1A** and **1B**, respectively, although in other embodiments the earphone may take different shapes and the exemplary shapes shown in FIGS. **1A** and **1B** are not intended to be limiting. In one embodiment, the earphone transitions automatically and seamlessly, without user intervention, between communication modes. That is, the earphone may

transition automatically from an ad hoc wireless network to an infrastructure wireless network, without user intervention. As used herein, an "ad hoc wireless network" is a network where two (or more) wireless-capable devices, such as the earphone and a data source, communicate directly and wirelessly, without using an access point. An "infrastructure wireless network," on the other hand, is a wireless network that uses one or more access points to allow a wireless-capable device, such as the wireless earphone, to connect to a computer network, such as a LAN or WAN (including the Internet).

FIGS. **1**A and **1**B show example configurations for a wireless earphone **10** according to various embodiments of the present invention. The examples shown in FIGS. **1**A and **1**B are not limiting and other configurations are within the scope of the present invention. As shown in FIGS. **1**A and **1**B, the earphone **10** may comprise a body **12**. The body **12** may comprise an ear canal portion **14** that is inserted in the ear canal of the user of the earphone **10**. In various embodiments, the body **12** also may comprise an exterior portion **15** that is not inserted into user's ear canal. The exterior portion **15** may comprise a knob **16** or some other user control (such as a dial, a pressure-activated switch, lever, etc.) for adjusting the shape of the ear canal portion **14**. That is, in various embodiments, activation (e.g. rotation) of the knob **16** may cause the ear canal portion **14** to change shape so as to, for example, radially expand to fit snugly against all sides of the user's ear canal. Further details regarding such a shape-changing earbud earphone are described in application PCT/US08/88656, filed 31 Dec. 2008, entitled "Adjustable Shape Earphone," which is incorporated herein by reference in its entirety. The earphone **10** also may comprise a transceiver circuit housed within the body **12**. The transceiver circuit, described further below, may transmit and receive the wireless signals, including receive streaming audio for playing by the earphone **10**. The transceiver circuit may be housed in the exterior portion **15** of the earphone **10** and/or in the ear canal portion **14**.

Although the example earphones **10** shown in FIGS. **1**A and **1**B include a knob **16** for adjusting the shape of the ear canal portion **14**, the present invention is not so limited, and in other embodiments, different means besides a knob **16** may be used to adjust the ear canal portion **14**. In addition, in other embodiments, the earphone **10** may not comprise a shape-changing ear canal portion **14**.

In various embodiments, the user may wear two discrete wireless earphones **10**: one in each ear. In such embodiments, each earphone **10** may comprise a transceiver circuit. In such embodiments, the earphones **10** may be connected by a string or some other cord-type connector to keep the earphones **10** from being separated.

In other embodiments, as shown in FIG. **1**C, a headband **19** may connect the two (left and right) earphones **10**. The headband **19** may be an over-the-head band, as shown in the example of FIG. **1**C, or the headband may be a behind-the-head band. In embodiments comprising a headband **19**, each earphone **10** may comprise a transceiver circuit; hence, each earphone **10** may receive and transmit separately the wireless communication signals. In other embodiments comprising a headband **19**, only one earphone **10** may comprise the transceiver circuit, and a wire may run along the headband **19** to the other earphone **10** to connect thereby the transceiver circuit to the acoustic transducer in the earphone that does not comprise the transceiver circuit. The embodiment shown in FIG. **1**C comprises on-ear earphones **10**; in other embodiments, in-ear or over-ear earphones may be used.

In other embodiments, the earphone **10** may comprise a hanger bar **17** that allows the earphone **10** to clip to, or hang on, the user's ear, as shown in the illustrated embodiment of FIGS. **1**D-**1**E. FIG. **1**D is a perspective view of the earphone and FIG. **1**E is a side view according to one embodiment. As shown in the illustrated embodiment, the earphone **10** may comprise dual speaker elements **106**-A, **106**-B. One of the speaker elements (the smaller one) **106**-A is sized to fit into the cavum concha of the listener's ear and the other element (the larger one) **106**-B is not. The listener may use the hanger bar to position the earphone on the listener's ear. In that connection, the hanger bar may comprise a horizontal section that rests upon the upper external curvature of the listener's ear behind the upper portion of the auricula (or pinna). The earphone may comprise a knurled knob that allows the user to adjust finely the distance between the horizontal section of the hanger bar and the speaker elements, thereby providing, in such embodiments, another measure of adjustability for the user. More details regarding such a dual element, adjustable earphone may be found in U.S. provisional patent application Ser. No. 61/054,238, which is incorporated herein by reference in its entirety.

FIGS. **2**A-**2**D illustrate various communication modes for a wireless data communication system involving the earphone **10** according to embodiments of the present invention. As shown in FIG. **2**A, the system comprises a data source **20** in communication with the earphone **10** via an ad hoc wireless network **24**. The earphone **10**, via its transceiver circuit (described in more detail below), may communicate wirelessly with a data source **20**, which may comprise a wireless network adapter **22** for transmitting the digital audio wirelessly. For example, the data source **20** may be a digital audio player (DAP), such as an mp3 player or an iPod, or any other suitable digital audio playing device, such as a laptop or personal computer, that stores and/or plays digital audio files. In other embodiments, the data source **20** may generate analog audio, and the wireless network adapter **22** may encode the analog audio into digital format for transmission to the earphone **10**.

The wireless network adapter **22** may be an integral part of the data source **20**, or it may be a separate device that is connected to the data source **20** to provide wireless connectivity for the data source **20**. For example, the wireless network adapter **22** may comprise a wireless network interface card (WNIC) or other suitable transceiver that plugs into a USB port or other port or jack of the data source **20** (such as a TRS connector) to stream data, e.g., digital audio files, via a wireless network (e.g., the ad hoc wireless network **24** or an infrastructure wireless network). The digital audio transmitted from the data source **20** to the earphone **10** via the wireless networks may comprise compressed or uncompressed audio. Any suitable file format may be used for the audio, including mp3, lossy or lossless WMA, Vorbis, Musepack, FLAC, WAV, AIFF, AU, or any other suitable file format.

When in range, the data source **20** may communicate with the earphone **10** via the ad hoc wireless network **24** using any suitable wireless communication protocol, including Wi-Fi (e.g., IEEE 802.11a/b/g/n), WiMAX (IEEE 802.16), Bluetooth, Zigbee, UWB, or any other suitable wireless communication protocol. For purposes of the description to follow, it is assumed that the data source **20** and the earphone **10** communicate using a Wi-Fi protocol, although the invention is not so limited and other wireless communication protocols may be used in other embodiments of the invention. The data source **20** and the earphone **10** are considered in range for the ad hoc wireless network **24** when the signal

strengths (e.g., the RSSI) of the signals received by the two devices are above a threshold minimum signal strength level. For example, the data source **20** and the earphone **10** are likely to be in range for an ad hoc wireless network when then are in close proximity, such as when the wearer of the earphone **10** has the data source **20** on his/her person, such as in a pocket, strapped to their waist or arm, or holding the data source in their hand.

When the earphone **10** and the data source **20** are out of range for the ad hoc wireless network **24**, that is, when the received signals degrade below the threshold minimum signal strength level, both the earphone **10** and the data source **20** may transition automatically to communicate over an infrastructure wireless network (such as a wireless LAN (WLAN)) **30** that is in the range of both the earphone **10** and the data source **20**, as shown in FIG. **2B**. The earphone **10** and the data source **20** (e.g., the wireless network adapter **22**) may include firmware, as described further below, that cause the components to make the transition to a common infrastructure wireless network **30** automatically and seamlessly, e.g., without user intervention. The earphone **10** may cache the received audio in a buffer or memory for a time period before playing the audio. The cached audio may be played after the connection over the ad hoc wireless network is lost to give the earphone **10** and the data source **20** time to connect via the infrastructure wireless network.

For example, as shown in FIG. **2B**, the infrastructure network may comprise an access point **32** that is in the range of both the data source **20** and the earphone **10**. The access point **32** may be an electronic hardware device that acts as a wireless access point for, and that is connected to, a wired and/or wireless data communication network **33**, such as a LAN or WAN, for example. The data source **20** and the earphone **10** may both communicate wirelessly with the access point **32** using the appropriate network data protocol (a Wi-Fi protocol, for example). The data source **20** and the earphone **10** may both transition automatically to an agreed-upon WLAN **30** that is in the range of both devices when they cannot communicate satisfactorily via the ad hoc wireless network **24**. A procedure for specifying an agreed-upon infrastructure wireless network **30** is described further below. Alternatively, the infrastructure wireless network **30** may have multiple access points **32***a-b*, as shown in FIG. **2C**. In such an embodiment, the data source **20** may communicate wirelessly with one access point **32***b* and the earphone **10** may communicate wirelessly with another access point **32***a* of the same infrastructure wireless network **30**. Again, the data source **20** and the earphone **10** may transition to an agreed-upon WLAN.

If there is no suitable common infrastructure wireless network over which the earphone **10** and the data source **20** can communicate, as shown in FIG. **2D**, the earphone **10** may transition to communicate with an access point **32***a* for an available (first) wireless network (e.g., WLAN) **30***a* that is in the range of the earphone **10**. In this mode, the earphone **10** may connect via the wireless network **30***a* to a network-enabled host server **40**. The host server **40** may be connected to the wireless network **30***a* via an electronic data communication network **42**, such as the Internet. In one mode, the host server **40** may transmit streaming digital audio via the networks **33***a*, **42** to the earphone **10**. In another mode, the host server **40** may transmit to the earphone **10** a network address, such as an Internet Protocol (IP) address, for a streaming digital audio content server **70** on the network **42**. Using the received IP address, the earphone **10** may connect to the streaming digital audio content server **70** via the networks **30***a*, **42** to receive and process digital audio from the streaming digital audio content server **70**.

The digital audio content server **70** may be, for example, an Internet radio station server. The digital audio content server **70** may stream digital audio over the network **42** (e.g., the Internet), which the earphone **10** may receive and process. In one embodiment, the streaming digital audio content server **70** may stream digital audio received by the streaming digital audio content server **70** from the data source **20**. For example, where the data source **20** is a wireless-capable device, such as a portable DAP, the data source **20** may connect to the streaming digital audio content server **70** via a wireless network **30***b* and the network **42**. Alternatively, where for example the data source **20** is non-wireless-capable device, such as a PC, the data source **20** may have a direct wired connection to the network **42**. After being authenticated by the streaming digital audio content server **70**, the data source **20** may stream digital audio to the streaming digital audio content server **70**, which may broadcast the received digital audio over the network **42** (e.g., the Internet). In such a manner, the user of the earphone **10** may listen to audio from the data source **20** even when (i) the earphone **10** and the data source **20** are not in communication via an ad hoc wireless network **24** and (ii) the earphone **10** and the data source **20** are not in communication via a common local infrastructure wireless network **30**.

FIG. **3** is a block diagram of the earphone **10** according to various embodiments of the present invention. In the illustrated embodiment, the earphone **10** comprises a transceiver circuit **100** and related peripheral components. As shown in FIG. **3**, the peripheral components of the earphone **10** may comprise a power source **102**, a microphone **104**, one or more acoustic transducers **106** (e.g., speakers), and an antenna **108**. The transceiver circuit **100** and some of the peripheral components (such as the power source **102** and the acoustic transducers **106**) may be housed within the body **12** of the earphone **10** (see FIG. **1**). Other peripheral components, such as the microphone **104** and the antenna **108** may be external to the body **12** of the earphone **10**. In addition, some of the peripheral components, such as the microphone **104**, are optional in various embodiments.

In various embodiments, the transceiver circuit **100** may be implemented as a single integrated circuit (IC), such as a system-on-chip (SoC), which is conducive to miniaturizing the components of the earphone **10**, which is advantageous if the earphone **10** is to be relatively small in size, such as an in-ear earphone (see FIGS. **1A-1B** for example). In alternative embodiments, however, the components of the transceiver circuit **100** could be realized with two or more discrete ICs or other components, such as separate ICs for the processors, memory, and RF (e.g., Wi-Fi) module, for example.

The power source **102** may comprise, for example, a rechargeable or non-rechargeable battery (or batteries). In other embodiments, the power source **102** may comprise one or more ultracapacitors (sometimes referred to as supercapacitors) that are charged by a primary power source. In embodiments where the power source **102** comprises a rechargeable battery cell or an ultracapacitor, the battery cell or ultracapacitor, as the case may be, may be charged for use, for example, when the earphone **10** is connected to a docking station or computer. The docking station may be connected to or part of a computer device, such as a laptop computer or PC. In addition to charging the rechargeable power source **102**, the docking station and/or computer may facilitate downloading of data to and/or from the earphone

10. In other embodiments, the power source 102 may comprise capacitors passively charged with RF radiation, such as described in U.S. Pat. No. 7,027,311. The power source 102 may be coupled to a power source control module 103 of transceiver circuit 100 that controls and monitors the power source 102.

The acoustic transducer(s) 106 may be the speaker element(s) for conveying the sound to the user of the earphone 10. According to various embodiments, the earphone 10 may comprise one or more acoustic transducers 106. For embodiments having more than one transducer, one transducer may be larger than the other transducer, and a crossover circuit (not shown) may transmit the higher frequencies to the smaller transducer and may transmit the lower frequencies to the larger transducer. More details regarding dual element earphones are provided in U.S. Pat. No. 5,333,206, assigned to Koss Corporation, which is incorporated herein by reference in its entirety.

The antenna 108 may receive and transmit the wireless signals from and to the wireless networks 24, 30. A RF (e.g., Wi-Fi) module 110 of the transceiver circuit 100 in communication with the antenna 108 may, among other things, modulate and demodulate the signals transmitted from and received by the antenna 108. The RF module 110 communicates with a baseband processor 112, which performs other functions necessary for the earphone 10 to communicate using the Wi-Fi (or other communication) protocol.

The baseband processor 112 may be in communication with a processor unit 114, which may comprise a microprocessor 116 and a digital signal processor (DSP) 118. The microprocessor 116 may control the various components of the transceiver circuit 100. The DSP 114 may, for example, perform various sound quality enhancements to the digital audio received by the baseband processor 112, including noise cancellation and sound equalization. The processor unit 114 may be in communication with a volatile memory unit 120 and a non-volatile memory unit 122. A memory management unit 124 may control the processor unit's access to the memory units 120, 122. The volatile memory 122 may comprise, for example, a random access memory (RAM) circuit. The non-volatile memory unit 122 may comprise a read only memory (ROM) and/or flash memory circuits. The memory units 120, 122 may store firmware that is executed by the processor unit 114. Execution of the firmware by the processor unit 114 may provide various functionality for the earphone 10, such as the automatic transition between wireless networks as described herein. The memory units 120, 122 may also cache received digital audio.

A digital-to-analog converter (DAC) 125 may convert the digital audio from the processor unit 114 to analog form for coupling to the acoustic transducer(s) 106. An I^2S interface 126 or other suitable serial or parallel bus interface may provide the interface between the processor unit 114 and the DAC 125. An analog-to-digital converter (ADC) 128, which also communicates with the I^2S interface 126, may convert analog audio signals picked up by the microphone 104 for processing by the processor unit 114.

The transceiver circuit 100 also may comprise a USB or other suitable interface 130 that allows the earphone 10 to be connected to an external device via a USB cable or other suitable link. As shown in FIG. 4A, the external device may be a docking station 200 connected to a computer device 202. Also, in various embodiments, the earphone 10 could be connected directly to the computer 202 without the docking station 200. In addition, the external device may be a DAP 210, as shown in FIG. 4B. In that way, the earphone

10 could connect directly to a data source 20, such as the DAP 210 or the computer 202, through the USB port 130. In addition, through the USB port 130, the earphone 10 may connect to a PC 202 or docking station 202 to charge up the power source 102 and/or to get downloads (e.g., data or firmware).

According to various embodiments, the earphone 10 may have an associated web page that a user may access through the host server 40 (see FIG. 2D) or some other server. An authenticated user could log onto the website from a client computing device 50 (e.g., laptop, PC, handheld computer device, etc., including the data source 20) (see FIG. 2D) to access the web page for the earphone 10 to set various profile values for the earphone 10. For example, at the web site, the user could set various content features and filters, as well as adjust various sound control features, such as treble, bass, frequency settings, noise cancellation settings, etc. In addition, the user could set preferred streaming audio stations, such as preferred Internet radio stations or other streaming audio broadcasts. That way, instead of listening to streaming audio from the data source 20, the user could listen to Internet radio stations or other streaming audio broadcasts received by the earphone 10. In such an operating mode, the earphone user, via the web site, may prioritize a number of Internet radio stations or other broadcast sources (hosted by streaming digital audio content servers 70). With reference to FIG. 7, the host server 40 may send the IP address for the earphone user's desired (e.g., highest priority) Internet radio station to the earphone 10. A button 11 on the earphone 10, such as on the rotating dial 16 as shown in the examples of FIGS. 1A and 1B, may allow the user to cycle through the preset preferred Internet radio stations. That is, for example, when the user presses the button 11, an electronic communication may be transmitted to the host server 40 via the wireless network 30, and in response to receiving the communication, the host server 40 may send the IP address for the user's next highest rated Internet radio station via the network 42 to the earphone 10. The earphone 10 may then connect to the streaming digital audio content server 70 for that Internet radio station using the IP address provided by the host server 40. This process may be repeated, e.g., cycled through, for each preset Internet radio station configured by the user of the earphone 10.

At the web site for the earphone 10 hosted on the host server 40, in addition to establishing the identification of digital audio sources (e.g., IDs for the user's DAP or PC) and earphones, the user could set parental or other user controls. For example, the user could restrict certain Internet radio broadcasts based on content or parental ratings, etc. That is, for example, the user could configure a setting through the web site that prevents the host server 40 from sending an IP address for a streaming digital audio content server 70 that broadcasts explicit content based on a rating for the content. In addition, if a number of different earphones 10 are registered to the same user, the user could define separate controls for the different earphones 10 (as well as customize any other preferences or settings particular to the earphones 10, including Internet radio stations, sound quality settings, etc. that would later be downloaded to the earphones 10). In addition, in modes where the host server 40 streams audio to the earphone 10, the host server 40 may log the files or content streamed to the various earphones 10, and the user could view at the web site the files or content that were played by the earphones 10. In that way, the user could monitor the files played by the earphones 10.

In addition, the host server **40** may provide a so-called eavesdropping function according to various embodiments. The eavesdropping service could be activated via the web site. When the service is activated, the host server **40** may transmit the content that it is delivering to a first earphone **10***a* to another, second earphone **10***b*, as shown in FIG. **8**. Alternatively, the host server **40** may transmit to the second earphone **10***b* the most recent IP address for a streaming digital audio content server **70** that was sent to the first earphone **10***a*. The second earphone **10***b* may then connect to the streaming digital audio content server **70** that the first earphone **10***a* is currently connected. That way, the user of the second earphone **10***b*, which may be a parent, for example, may directly monitor the content being received by the first earphone **10***a*, which may belong to a child of the parent.

This function also could be present in the earphones **10** themselves, allowing a parent (or other user) to join an ad-hoc wireless network and listen to what their child (or other listener) is hearing. For example, with reference to FIG. **10**, a first earphone **10***a* may receive wireless audio, such as from the data source **20** or some other source, such as the host server **40**. The first earphone **10***a* may be programmed with firmware to broadcast the received audio to a second earphone **10***b* via an ad hoc wireless network **24**. That way, the wearer of the second earphone **10***b* can monitor in real-time the content being played by the first earphone **10***a*.

At the web site, the user may also specify the identification number ("ID") of their earphone(s) **10**, and the host server **40** may translate the ID to the current internet protocol (IP) addresses for the earphone **10** and for the data source **20**. This allows the user to find his or her data source **20** even when it is behind a firewall or on a changing IP address. That way, the host server **40** can match the audio from the data source **20** to the appropriate earphone **10** based on the specified device ID. The user also could specify a number of different data sources **20**. For example, the user's DAP may have one specified IP address and the user's home (or work) computer may have another specified IP address. Via the web site hosted by the host server **40**, the user could specify or prioritize from which source (e.g., the user's DAP or computer) the earphone **10** is to receive content.

The host server **40** (or some other server) may also push firmware upgrades and/or data updates to the earphone **10** using the IP addresses of the earphone **10** via the networks **30**, **42**. In addition, a user could download the firmware upgrades and/or data updates from the host server **40** to the client computing device **202** (see FIG. 4A) via the Internet, and then download the firmware upgrades and/or data updates to the earphone **10** when the earphone **10** is connected to the client computer device **202** (such as through a USB port and/or the docking station **200**).

Whether the downloads are transmitted wirelessly to the earphone **10** or via the client computing device **202** may depend on the current data rate of the earphone **10** and the quantity of data to be transmitted to the earphone **10**. For example, according to various embodiments, as shown in the process flow of FIG. **5**, the host server **40** may be programmed, at step **50**, to make a determination, based on the current data rate for the earphone **10** and the size of the update, whether the update should be pushed to the earphone **10** wirelessly (e.g., via the WLAN **30***a* in FIG. 2D). If the update is too large and/or the current data rate is too low that the performance of the earphone **10** will be adversely affected, the host server **40** may refrain from pushing the update to the earphone **10** wirelessly and wait instead to download the update to the client computing device **202** at step **51**. Conversely, if the host server **40** determines that, given the size of the update and the current data rate for the earphone **10** that the performance of the earphone **10** will not be adversely affected, the host server **40** may transmit the update wirelessly to the earphone **10** at step **52**.

As mentioned above, the processor unit **114** of the speakerphones **14** may be programmed, via firmware stored in the memory **120**, **122**, to have the ability to transition automatically from the ad hoc wireless network **24** to an infrastructure wireless network **30** (such as a WLAN) when the quality of the signal on the ad hoc wireless network **24** degrades below a suitable threshold (such as when the data source **20** is out of range for an ad hoc wireless network). In that case, the earphone **10** and the data source **20** may connect to a common infrastructure wireless network (e.g., WLAN) (see, for example, FIGS. **2B-2C**). Through the web site for the earphone **10**, described above, the user could specify a priority of infrastructure wireless networks **30** for the data source **20** and the earphone **10** to connect to when the ad hoc wireless network **24** is not available. For example, the user could specify a WLAN servicing his/her residence first, a WLAN servicing his/her place of employment second, etc. During the time that the earphone **10** and the data source **20** are connected via the ad hoc wireless network **24**, the earphone **10** and the data source **20** may exchange data regarding which infrastructure networks are in range. When the earphone **10** and the data source **20** are no longer in range for the ad hoc wireless network **24** (that is, for example, the signals between the device degrade below an acceptable level), they may both transition automatically to the highest prioritized infrastructure wireless network whose signal strength is above a certain threshold level. That way, even though the earphone **10** and the data source **20** are out of range for the ad hoc wireless network **24**, the earphone **10** may still receive the streaming audio from the data source **20** via the infrastructure wireless network **30** (see FIGS. 2B-2C).

When none of the preferred infrastructure networks is in range, the earphone **10** may connect automatically to the host server **40** via an available infrastructure wireless network **30** (see FIG. 2D), e.g., the infrastructure wireless network **30** having the highest RSSI and to which the earphone **10** is authenticated to use. The host server **40**, as mentioned above, may transmit IP addresses to the earphone **10** for streaming digital audio content servers **70** or the host sever **40** may stream digital audio to the earphone **10** itself when in this communication mode.

FIG. **6** is a diagram of the process flow, according to one embodiment, implemented by the transceiver circuit **100** of the earphone **10**. The process shown in FIG. **6** may be implemented in part by the processor unit **114** executing firmware stored in a memory unit **120**, **122** of the transceiver circuit **100**. At step **61**, the earphone **10** may determine if it can communicate with the data source **20** via an ad hoc wireless network **24**. That is, the earphone **10** may determine if the strength of the wireless signals from the data source **20** exceed some minimum threshold. If so, the data source **20** and the earphone **10** may communicate wirelessly via the ad hoc wireless network **24** (see FIG. 2A). While in this communication mode, at step **62**, the data source **20** and the earphone **10** also may exchange data regarding the local infrastructure wireless networks, if any, in the range of the data source **20** and the earphone **10**, respectively. For example, the earphone **10** may transmit the ID of local infrastructure wireless networks **30** that the earphone **10** can detect whose signal strength (e.g., RSSI) exceeds some

minimum threshold level. Similarly, the data source **20** may transmit the ID the local infrastructure wireless networks **30** that the data source **20** can detect whose signal strength (e.g., RSSI) exceeds some minimum threshold level. The earphone **10** may save this data in a memory unit **120**, **122**. Similarly, the data source **20** may store in memory the wireless networks that the earphone **10** is detected.

The data source **20** and the earphone **10** may continue to communicate via the ad hoc wireless network mode **24** until they are out of range (e.g., the signal strengths degrade below a minimum threshold level). If an ad hoc wireless network **24** is not available at block **61**, the transceiver circuit **100** and the data source **20** may execute a process, shown at block **63**, to connect to the user's highest prioritized infrastructure wireless network **30**. For example, of the infrastructure wireless networks whose signal strength exceeded the minimum threshold for both the earphone **10** and the data source **20** determined at step **62**, the earphone **10** and the data source **20** may both transition to the infrastructure wireless network **30** having the highest priority, as previously set by the user (seen FIGS. **2B-2C**, for example). For example, if the user's highest prioritized infrastructure wireless network **30** is not available, but the user's second highest prioritized infrastructure wireless network **30** is, the earphone **10** and the data source **20** may both transition automatically to the user's second highest prioritized infrastructure wireless network **30** at block **64**. As shown by the loop with block **65**, the earphone **10** and the data source **20** may continue to communicate via one of the user's prioritized infrastructure wireless networks **30** as long as the infrastructure wireless network **30** is available. If the infrastructure wireless network becomes unavailable, the process may return to block **61**.

If, however, no ad hoc wireless network and none of the user's prioritized infrastructure wireless networks are available, the earphone **10** may transition automatically to connect to the host server **40** at block **66** (see FIG. 2D) using an available infrastructure wireless network **30**. At block **67**, the host server **40** may transmit an IP address to the earphone **10** for one of the streaming digital audio content servers **70**, and at block **68** the earphone **10** may connect to the streaming digital audio content server **70** using the received IP address. At step **69**, as long as the earphone **10** is connected to the streaming digital audio content server **70**, the earphone **10** may continue to communicate in this mode. However, if the earphone **10** loses its connection to the digital audio content server **70**, the process may return to block **61** in one embodiment. As mentioned above, at block **67**, instead of sending an IP address for a streaming digital audio content server **70**, the host server **40** may stream digital audio to the earphone **10**. The user, when configuring their earphone **10** preferences via the web site, may specify and/or prioritize whether the host server **40** is to send IP addresses for the streaming digital audio content servers **70** and/or whether the host server **40** is to stream audio to the earphone **10** itself.

In another embodiment, the earphone **10** may be programmed to transition automatically to the host server **40** when the earphone **10** and the data source **20** are not in communication via the ad hoc wireless network **24**. That is, in such an embodiment, the earphone **10** may not try to connect via a local infrastructure wireless network **30** with the data source **20**, but instead transition automatically to connect to the host server **40** (see FIG. 2D).

In various embodiments, as shown in FIG. 1B, the button **11** or other user selection device that allows the wearer of the earphone **10** to indicate approval and/or disapproval of songs or other audio files listened to by the wearer over an Internet radio station. The approval/disapproval rating, along with metadata for the song received by the earphone **10** with the streaming audio, may be transmitted from the transceiver circuit **100** of the earphone **10** back to the host server **40**, which may log the songs played as well as the ratings for the various songs/audio files. In addition to being able to view the logs at the website, the host server **40** (or some other server) may send an email or other electronic communication to the earphone user, at a user specified email address or other address, which the user might access from their client communication device **50** (see FIG. 2D). The email or other electronic communication may contain a listing of the song/audio files for which the user gave approval ratings using the button **11** or other user selection device. Further, the email or other electronic communication may provide a URL link for a URL at which the user could download song/audio files that the user rated (presumably song/audio files for which the user gave an approval rating). In some instances, the user may be required to pay a fee to download the song/audio file.

The user song ratings also may be used by the host server **40** to determine the user's musical preferences and offer new music that the user might enjoy. More details about generating user play lists based on song ratings may be found in published U.S. patent applications Pub. No. 2006/0212444, Pub. No. 2006/0206487, and Pub. No. 2006/0212442, and U.S. Pat. No. 7,003,515, which are incorporated herein by reference in their entirety.

In addition or alternatively, the user could log onto a web site hosted by the host server **40** (or some other server) to view the approval/disapproval ratings that the user made via the button **11** on the earphone **10**. The web site may provide the user with the option of downloading the rated songs/audio files (for the host server **40** or some other server system) to their client computer device **50**. The user could then have their earphone **10** connect to their client computer device **50** as a data source **20** via an ad hoc wireless network **24** (see FIG. **2A**) or via an infrastructure wireless network (see FIGS. **2B-2D**) to listen to the downloaded songs. In addition, the user could download the song files from their client computer device **50** to their DAP and listen to the downloaded song files from their DAP by using their DAP as the data source **20** in a similar manner.

Another application of the headsets may be in vehicles equipped with Wi-Fi or other wireless network connectivity. Published PCT application WO 2007/136620, which is incorporated herein by reference, discloses a wireless router for providing a Wi-Fi or other local wireless network for a vehicle, such as a car, truck, boat, bus, etc. In a vehicle having a Wi-Fi or other local wireless network, the audio for other media systems in the vehicle could be broadcast over the vehicle's wireless network. For example, if the vehicle comprises a DVD player, the audio from the DVD system could be transmitted to the router and broadcast over the vehicle's network. Similarly, the audio from terrestrial radio stations, a CD player, or an audio cassette player could be broadcast over the vehicle's local wireless network. The vehicle's passengers, equipped with the earphones **10**, could cycle through the various audio broadcasts (including the broadcasts from the vehicle's media system as well as broadcasts from the host server **40**, for example) using a selection button **11** on the earphone **10**. The vehicle may also be equipped with a console or terminal, etc., through which a passenger could mute all of the broadcasts for direct voice communications, for example.

As described above, the earphones **10** may also include a microphone **104**, as shown in the example of FIG. **9**. The headset **90** shown in FIG. **9** includes two earphones **10**, both of which may include a transceiver circuit **100** or only one of which may include the transceiver circuit, as discussed above. The microphone **104** could be used to broadcast communications from one earphone wearer to another earphone wearer. For example, one wearer could activate the microphone by pressing a button **92** on the headset **90**. The headset **90** may then transmit a communication via an ad hoc wireless network **24** or other wireless network to a nearby recipient (or recipients) equipped with a headset **90** with a transceiver circuit **100** in one or both of the earphones **10**. When such communication is detected by the recipient's headset **90**, the streaming audio received over the wireless network by the recipient's headset **90** may be muted, and the intercom channel may be routed to the transducer(s) of the recipient's headset **90** for playing for the recipient. This functionality may be valuable and useful where multiple wearers of the headsets **90** are in close proximity, such as on motorcycles, for example.

Another exemplary use of the earphones **10** is in a factory, warehouse, construction site, or other environment that might be noisy. Persons (e.g., workers) in the environment could use the earphones **10** for protection from the surrounding noise of the environment. From a console or terminal, a person (e.g., a supervisor) could select a particular recipient for a communication over the Wi-Fi network (or other local wireless network). The console or terminal may have buttons, dials, or switches, etc., for each user/recipient, or it could have one button or dial through which the sender could cycle through the possible recipients. In addition, the console or terminal could have a graphical user interface, through which the sender may select the desired recipient(s).

As mentioned above, the earphones **10** may comprise a USB port. In one embodiment, as shown in FIG. **11**, the user may use an adapter **150** that connects to the USB port of each earphone **10**. The adapter **150** may also have a plug connector **152**, such as a 3.5 mm jack, which allows the user to connect the adapter **150** to devices having a corresponding port for the connector **152**. When the earphones **10** detect a connection via their USB interfaces in such a manner, the Wi-Fi (or other wireless protocol) components may shut down or go into sleep mode, and the earphones **10** will route standard headphone level analog signals to the transducer(s) **106**. This may be convenient in environments where wireless communications are not permitted, such as airplanes, but where there is a convenient source of audio contact. For example, the adapter **150** could plug into a person's DAP. The DSP **118** of the earphone **10** may still be operational in such a non-wireless mode to provide noise cancellation and any applicable equalization.

The examples presented herein are intended to illustrate potential and specific implementations of the embodiments. It can be appreciated that the examples are intended primarily for purposes of illustration for those skilled in the art. No particular aspect of the examples is/are intended to limit the scope of the described embodiments.

According to various embodiments, therefore, the present invention is directed to an earphone **10** that comprises a body **12**, where the body **12** comprises: (i) at least one acoustic transducer **106** for converting an electrical signal to sound; (ii) an antenna **108**; and (iii) a transceiver circuit **100** in communication with the at least one acoustic transducer **106** and the antenna **108**. The transceiver circuit **100** is for receiving and transmitting wireless signals via the antenna **108**, and the transceiver circuit **100** is for outputting the electrical signal to the at least one acoustic transducer **106**. The wireless transceiver circuit also comprises firmware, which when executed by the transceiver circuit, causes the transceiver circuit to: (i) receive digital audio wirelessly from a data source **20** via an ad hoc wireless network **24** when the data source **20** is in wireless communication range with the earphone **10** via the ad hoc wireless network **24**; and (ii) when the data source **20** is not in wireless communication range with the earphone **10** via the ad hoc wireless network **24**, transition automatically to receive digital audio via an infrastructure wireless network **30**.

According to various implementations, the data source may comprise a portable digital audio player, such as an MP3 player, iPod, or laptop computer, or a nonportable digital audio player, such as a personal computer. In addition, the transceiver circuit **100** may comprise: (i) a wireless communication module **110** (such as a Wi-Fi or other wireless communication protocol module); (ii) a processor unit **114** in communication with the wireless communication module **110**; (iii) a non-volatile memory unit **122** in communication with the processor unit **114**; and (iv) a volatile memory **120** unit in communication with the processor unit **114**. The infrastructure wireless network may comprise a WLAN. The transceiver circuit **100** may receive digital audio from the data source **20** via the infrastructure wireless network **30** when the data source **20** is not in wireless communication range with the earphone **10** via the ad hoc wireless network **24**. The transceiver circuit firmware, when executed by the transceiver circuit **100**, may cause the transceiver circuit **100** of the earphone **10** to transition automatically to a pre-set infrastructure wireless network **30** that the data source **20** transitions to when the data source **20** is not in wireless communication range with the earphone **10** via the ad hoc wireless network **24** and when the pre-set infrastructure wireless network **30** is in range of both the earphone **10** and the data source **20**. In addition, the transceiver circuit firmware, when executed by the transceiver circuit **100**, may cause the transceiver circuit **100** of the earphone **10** to transmit data via the ad hoc wireless network **24** to the data source **20** regarding one or more infrastructure wireless networks **30** detected by the transceiver circuit **100** when the earphone **10** and the data source **20** are communicating via the ad hoc wireless network **24**.

In addition, the transceiver circuit firmware, when executed by the transceiver circuit **100**, may cause the transceiver circuit **100** of the earphone **10** to connect to a host server **40** via an available infrastructure wireless network **30** when the data source **20** is not in wireless communication range with the earphone **10** via the ad hoc wireless network **24**. The earphone **10** may receive streaming digital audio from the host server **40** via the infrastructure wireless network **30**. In addition, the earphone **10** may receive a first network address for a first streaming digital audio content server **70** from the host server **40** via the infrastructure wireless network **30**. In addition, the earphone **10** may comprise a user control, such as button **11**, dial, pressure switch, or other type of user control, that, when activated, causes the earphone **10** to transmit an electronic request via the infrastructure wireless network **30** to the host server **40** for a second network address for a second streaming digital audio content server **70**.

In other embodiments, the present invention is directed to a system that comprises: (i) a data source **20** for wirelessly transmitting streaming digital audio; and (ii) a wireless earphone **10** that is in wireless communication with the data source **20**. In yet other embodiments, the present invention is directed to a communication system that comprises: (i) a

host server **40**; (ii) a first streaming digital audio content server **70** that is connected to the host server **40** via a data network **42**; and (iii) a wireless earphone **10** that is in communication with the host server **40** via a wireless network **30**. The host server **40** is programmed to transmit to the earphone **10** a first network address for the first streaming digital audio content server **70** on the data network **42**. The host server **40** and the streaming digital audio content server(s) **70** each may comprise one or more processor circuits and one or more memory circuits (e.g., ROM circuits and/or RAM circuits).

In yet another embodiment, the present invention is directed to a headset that comprises: (i) a first earphone **10***a* that comprises one or more acoustic transducers **10***b* for converting a first electrical signal to sound; and (ii) a second earphone **10***b*, connected to the first earphone **10***a*, wherein the second earphone **10***b* comprises one or more acoustic transducers **10***b* for converting a second electrical signal to sound. In one embodiment, the first earphone **10***a* comprises: (i) a first antenna **108**; and (ii) a first transceiver circuit **100** in communication with the one or more acoustic transducers **106** of the first earphone **10***a* and in communication with the first antenna **108**. The first transceiver circuit **100** is for receiving and transmitting wireless signals via the first antenna **108**, and for outputting the first electrical signal to the one or more acoustic transducers **10***b* of the first earphone **10***a*. The first transceiver circuit **100** also may comprise firmware, which when executed by the first transceiver circuit **100**, causes the first transceiver circuit **100** to: (i) receive digital audio wirelessly from a data source **20** via an ad hoc wireless network **24** when the data source **20** is in wireless communication range with the first earphone **10***a* via the ad hoc wireless network **24**; and (ii) when the data source **20** is not in wireless communication range with the first earphone **10***a* via the ad hoc wireless network **24**, transition automatically to receive digital audio via an infrastructure wireless network **30**.

In various implementations, the headset further may comprise a head band **19** that is connected to the first and second earphones **10**. In addition, the headset **19** further may comprise a microphone **104** having an output connected to the first transceiver circuit **100**. In one embodiment, the first transceiver circuit **100** is for outputting the second electrical signal to the one or more acoustic transducers **106** of the second earphone **10***b*. In another embodiment, the second earphone **10***b* comprises: (i) a second antenna **108**; and (ii) a second transceiver circuit **100** in communication with the one or more acoustic transducers **106** of the second earphone **10***b* and in communication with the second antenna **108**. The second transceiver circuit **100** is for receiving and transmitting wireless signals via the second antenna **108**, and for outputting the second electrical signal to the one or more acoustic transducers **106** of the second earphone **10***b*. The second transceiver circuit **100** may comprise firmware, which when executed by the second transceiver circuit **100**, causes the second transceiver circuit **100** to: (i) receive digital audio wirelessly from the data source **20** via the ad hoc wireless network **24** when the data source **20** is in wireless communication range with the second earphone **10***b* via the ad hoc wireless network **24**; and (ii) when the data source **20** is not in wireless communication range with the second earphone **10***b* via the ad hoc wireless network **24**, transition automatically to receive digital audio via the infrastructure wireless network **30**.

In addition, according to various embodiments, the first earphone **10***a* may comprise a first data port and the second earphone **10***b* may comprise a second data port. In addition, the headset may further comprise an adapter or dongle **150** connected to the first data port of the first earphone **10***a* and to the second data port of the second earphone **10***b*, wherein the adapter **150** comprises an output plug connector **152** for connecting to a remote device.

In addition, according to other embodiments, the present invention is directed to a method that comprises the steps of: (i) receiving, by a wireless earphone, via an ad hoc wireless network, digital audio from a data source when the data source is in wireless communication with the earphone via the ad hoc wireless network; (ii) converting, by the wireless earphone, the digital audio to sound; and (iii) when the data source is not in wireless communication with the earphone, transitioning automatically, by the earphone, to receive digital audio via an infrastructure wireless network.

In various implementations, the step of transitioning automatically by the earphone to receive digital audio via an infrastructure wireless network may comprises transitioning automatically to receive digital audio from the data source via an infrastructure wireless network when the data source is not in wireless communication range with the earphone via the ad hoc wireless network. In addition, the method may further comprise the step of receiving by the wireless earphone from the data source via the ad hoc wireless network data regarding one or more infrastructure wireless networks detected by data source when the earphone and the data source are communicating via the ad hoc wireless network.

In addition, the step of transitioning automatically by the earphone to receive digital audio via an infrastructure wireless network comprises may transitioning automatically to receive digital audio from a host sever via the infrastructure wireless network when the data source is not in wireless communication range with the earphone via the ad hoc wireless network. Additionally, the step of transitioning automatically by the earphone to receive digital audio via an infrastructure wireless network may comprise: (i) receiving, by the wireless earphone via the infrastructure wireless network, from a host server connected to the infrastructure wireless network, a network address for a streaming digital audio content server; and (ii) connecting, by the wireless earphone, to the streaming digital audio content server using the network address received from the host server.

It is to be understood that the figures and descriptions of the embodiments have been simplified to illustrate elements that are relevant for a clear understanding of the embodiments, while eliminating, for purposes of clarity, other elements. For example, certain operating system details for the various computer-related devices and systems are not described herein. Those of ordinary skill in the art will recognize, however, that these and other elements may be desirable in a typical processor or computer system. Because such elements are well known in the art and because they do not facilitate a better understanding of the embodiments, a discussion of such elements is not provided herein.

In general, it will be apparent to one of ordinary skill in the art that at least some of the embodiments described herein may be implemented in many different embodiments of software, firmware and/or hardware. The software and firmware code may be executed by a processor or any other similar computing device. The software code or specialized control hardware that may be used to implement embodiments is not limiting. For example, embodiments described herein may be implemented in computer software using any suitable computer software language type. Such software may be stored on any type of suitable computer-readable medium or media, such as, for example, a magnetic or

optical storage medium. The operation and behavior of the embodiments may be described without specific reference to specific software code or specialized hardware components. The absence of such specific references is feasible, because it is clearly understood that artisans of ordinary skill would be able to design software and control hardware to implement the embodiments based on the present description with no more than reasonable effort and without undue experimentation.

Moreover, the processes associated with the present embodiments may be executed by programmable equipment, such as computers or computer systems and/or processors. Software that may cause programmable equipment to execute processes may be stored in any storage device, such as, for example, a computer system (nonvolatile) memory, an optical disk, magnetic tape, or magnetic disk. Furthermore, at least some of the processes may be programmed when the computer system is manufactured or stored on various types of computer-readable media.

A "computer," "computer system," "host," "host server," "server," or "processor" may be, for example and without limitation, a processor, microcomputer, minicomputer, server, mainframe, laptop, personal data assistant (PDA), wireless e-mail device, cellular phone, pager, processor, fax machine, scanner, or any other programmable device configured to transmit and/or receive data over a network. Such components may comprise: one or more processor circuits; and one more memory circuits, including ROM circuits and RAM circuits. Computer systems and computer-based devices disclosed herein may include memory for storing certain software applications used in obtaining, processing, and communicating information. It can be appreciated that such memory may be internal or external with respect to operation of the disclosed embodiments. The memory may also include any means for storing software, including a hard disk, an optical disk, floppy disk, ROM (read only memory), RAM (random access memory), PROM (programmable ROM), EEPROM (electrically erasable PROM) and/or other computer-readable media.

In various embodiments disclosed herein, a single component may be replaced by multiple components and multiple components may be replaced by a single component to perform a given function or functions. Except where such substitution would not be operative, such substitution is within the intended scope of the embodiments. Any servers described herein, such as the host server **40**, for example, may be replaced by a "server farm" or other grouping of networked servers (such as server blades) that are located and configured for cooperative functions. It can be appreciated that a server farm may serve to distribute workload between/among individual components of the farm and may expedite computing processes by harnessing the collective and cooperative power of multiple servers. Such server farms may employ load-balancing software that accomplishes tasks such as, for example, tracking demand for processing power from different machines, prioritizing and scheduling tasks based on network demand and/or providing backup contingency in the event of component failure or reduction in operability.

While various embodiments have been described herein, it should be apparent that various modifications, alterations, and adaptations to those embodiments may occur to persons skilled in the art with attainment of at least some of the advantages. The disclosed embodiments are therefore intended to include all such modifications, alterations, and adaptations without departing from the scope of the embodiments as set forth herein.

What is claimed is:

1. A headphone assembly comprising:

first and second earphones, wherein each of the first and second earphones comprises an acoustic transducer; and

an antenna for receiving wireless signals from a mobile, digital audio player via one or more ad hoc wireless communication links;

a wireless communication circuit connected to the antenna, wherein the wireless communication circuit is for receiving and transmitting wireless signals to and from the headphone assembly;

a processor;

a memory for storing firmware that is executed by the processor;

a rechargeable battery for powering the headphone assembly; and

a microphone for picking up utterances by a user of the headphone assembly; and

wherein the headphone assembly is configured to play, by the first and second earphones, digital audio content transmitted by the mobile, digital audio player via the one or more ad hoc wireless communication links;

wherein the processor is configured to, upon activation of a user-control of the headphone assembly, initiate transmission of a request to a remote, network-connected server that is in wireless communication with the mobile, digital audio player; and

wherein the headphone assembly is for receiving firmware upgrades transmitted from the remote, network-connected server.

2. The headphone assembly of claim **1**, wherein:

in a first audio play mode, the first and second earphones play audio content stored on a mobile, digital audio player and transmitted to the headphone assembly from the mobile, digital audio player via the one or more ad hoc wireless communication links; and

in a second audio play mode, the earphones play audio content streamed from the remote, network-connected server.

3. The headphone assembly of claim **2**, wherein the processor is for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

4. The headphone assembly of claim **3**, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

5. The headphone assembly of claim **1**, wherein the processor is for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

6. The headphone assembly of claim 5, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

7. The headphone assembly of claim 1, wherein upon activation of the microphone by the user, data are transmitted about the headphone assembly to a remote device.

8. The headphone assembly of claim 1, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

9. The headphone assembly of claim 1, wherein the headphone assembly is for receiving firmware upgrades wirelessly.

10. The headphone assembly of claim 1, wherein:

the wireless communication circuit is located in the first earphone; and

the headphone assembly further comprises a connection wire between the first and second earphones to carry the received digital audio content from the first earphone to the second earphone.

11. The headphone assembly of claim 10, wherein the processor is for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

12. The headphone assembly of claim 11, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

13. The headphone assembly of claim 10, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

14. The headphone assembly of claim 10, wherein the headphone assembly further comprises a headband, and wherein the headband carries the connection wire.

15. The headphone assembly of claim 14, wherein:

in a first audio play mode, the first and second earphones play audio content stored on the mobile, digital audio player and transmitted to the headphone assembly from the mobile, digital audio player via the one or more ad hoc wireless communication links; and

in a second audio play mode, the earphones play audio content streamed from the remote, network-connected server.

16. The headphone assembly of claim 15, wherein the processor is for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

17. The headphone assembly of claim 16, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

18. The headphone assembly of claim 15, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

19. The headphone assembly of claim 14, wherein the processor is for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

20. The headphone assembly of claim 19, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

21. The headphone assembly of claim 14, wherein upon activation of the microphone by the user, data are transmitted about the headphone assembly to a remote device.

22. The headphone assembly of claim 14, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

23. The headphone assembly of claim 10, wherein each of the first and second earphones further comprises:

an adjustable, curved hanger bar that sits upon an upper external curvature of the user's ear, behind an upper portion of an auricula of the user's ear, when the headphone assembly is worn by the user; and

a body connected to the hanger bar, wherein the earphone extends from the body into the user's ear when the headphone assembly is worn by the user.

24. The headphone assembly of claim **23**, wherein:

in a first audio play mode, the first and second earphones play audio content stored on the mobile, digital audio player and transmitted to the headphone assembly from the mobile, digital audio player via the one or more ad hoc wireless communication links; and

in a second audio play mode, the earphones play audio content streamed from the remote, network-connected server.

25. The headphone assembly of claim **24**, wherein:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

26. The headphone assembly of claim **25**, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

27. The headphone assembly of claim **24**, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

28. The headphone assembly of claim **23**, wherein the processor is for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

29. The headphone assembly of claim **28**, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

30. The headphone assembly of claim **23**, wherein upon activation of the microphone by the user, data are transmitted about the headphone assembly to a remote device.

31. The headphone assembly of claim **23**, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

32. The headphone assembly of claim **1**, wherein:

the wireless circuit comprises first and second wireless circuits;

the first wireless circuit is in the first earphone; and

the second wireless circuit is in the second earphone.

33. The headphone assembly of claim **32**, wherein each of the first and second earphones comprise earbuds.

34. The headphone assembly of claim **33**, wherein each of the first and second earphones comprises:

a body portion that sits at least partially in an ear of the user when the headphone assembly is worn by the user; and

an elongated portion that extends from the body portion.

35. The headphone assembly of claim **34**, wherein at least one of the first and second earphones is charged by a docking station.

36. The headphone assembly of claim **35**, wherein:

in a first audio play mode, the first and second earphones play audio content stored on a mobile, digital audio player and transmitted to the headphone assembly from the mobile, digital audio player via the one or more ad hoc wireless communication links; and

in a second audio play mode, the earphones play audio content streamed from the remote, network-connected server.

37. The headphone assembly of claim **36**, wherein the processor is for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

38. The headphone assembly of claim **36**, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

39. The headphone assembly of claim **35**, wherein the processor is for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

40. The headphone assembly of claim **39**, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second

wireless communication link, wherein the second digital audio source is different from the first digital audio source.

41. The headphone assembly of claim 34, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

42. The headphone assembly of claim 33, wherein each of the first and second earphones further comprises:

an adjustable, curved hanger bar that sits upon an upper external curvature of the user's ear, behind an upper portion of an auricula of the user's ear, when the headphone assembly is worn by the user; and

a body connected to the hanger bar, wherein the earphone extends from the body into the user's ear when the headphone assembly is worn by the user.

43. The headphone assembly of claim 42, wherein at least one of the first and second earphones is charged by a docking station.

44. The headphone assembly of claim 42, wherein:

the mobile, digital audio player is a first digital audio source;

the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

45. The headphone assembly of claim 42, wherein upon activation of the microphone by the user, data are transmitted about the headphone assembly to a remote device.

46. The headphone assembly of claim 42, wherein the headphone assembly is for receiving firmware upgrades transmitted from the remote, network-connected server.

47. The headphone assembly of claim 1, wherein the headphone assembly further comprises first and second integrated circuits, wherein the first integrated circuit comprises the wireless communication circuit and the second integrated circuit, which is separate from the first integrated circuit, comprises the processor.

48. The headphone assembly of claim 1, wherein each of the first and second earphones further comprises:

an adjustable, curved hanger bar that sits upon an upper external curvature of the user's ear, behind an upper portion of an auricula of the user's ear, when the headphone assembly is worn by the user; and

a body connected to the hanger bar, wherein the earphone extends from the body into the user's ear when the headphone assembly is worn by the user.

49. The headphone assembly of claim 1, wherein each of the first and second earphones comprise earbuds.

50. The headphone assembly of claim 1, wherein each of the first and second earphones comprise on-ear speaker elements.

51. The headphone assembly of claim 1, wherein each of the first and second earphones comprise over-ear speaker elements.

52. The headphone assembly of claim 1, wherein the processor comprises a digital signal processor that provides a sound quality enhancement for the audio content played by the acoustic transducers.

53. The headphone assembly of claim 52, further comprising a baseband processor circuit that is in communication with the wireless communication circuit.

54. The headphone assembly of claim 1, wherein each of the first and second earphones comprise:

an antenna for receiving wireless signals from the mobile, digital audio player via the one or more ad hoc wireless communication links;

a wireless communication circuit connected to the antenna, wherein the wireless communication circuit is for receiving and transmitting wireless signals to and from the headphone assembly;

a processor;

a memory for storing firmware that is executed by the processor; and

a rechargeable battery for powering the headphone assembly.

55. The headphone assembly of claim 54, wherein each of the first and second earphones comprise an earbud.

56. The headphone assembly of claim 55, wherein the processor of each of the first and second earphones comprises a digital signal processor that provides a sound quality enhancement for the audio content played by the acoustic transducer of the earphone.

57. The headphone assembly of claim 56, wherein the processor of each of the first and second earphones comprises a baseband processor circuit that is in communication with the wireless communication circuit of the earphone.

58. A headphone assembly comprising:

first and second earphones, wherein each of the first and second earphones comprises an acoustic transducer; and

an antenna for receiving wireless signals from a mobile, digital audio player via one or more ad hoc wireless communication link, wherein the mobile, digital audio player is a first digital audio source;

a wireless communication circuit connected to the antenna, wherein the wireless communication circuit is for receiving and transmitting wireless signals to and from the headphone assembly;

a processor;

a rechargeable battery for powering the headphone assembly; and

a microphone for picking up utterances by a user of the headphone assembly; and

wherein the headphone assembly is configured to play, by the first and second earphones, digital audio content transmitted by the mobile, digital audio player via the one or more ad hoc wireless communication links;

wherein the processor is configured to, upon activation of a user-control of the headphone assembly, initiate transmission of a request to a remote, network-connected server that is in wireless communication with the mobile, digital audio player; and

wherein the headphone assembly transitions to play digital audio content received wirelessly from a second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link, wherein the second digital audio source is different from the first digital audio source.

59. The headphone assembly of claim **58**, wherein:

in a first audio play mode, the first and second earphones play audio content stored on the mobile, digital audio player and transmitted to the headphone assembly from the mobile, digital audio player via the one or more ad hoc wireless communication links; and

in a second audio play mode, the earphones play audio content streamed from the remote, network-connected server.

60. The headphone assembly of claim **59**, wherein the processor is for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

61. The headphone assembly of claim **58**, wherein upon activation of the microphone by the user, data are transmitted about the headphone assembly to a remote device.

62. The headphone assembly of claim **58**, wherein the headphone assembly is for receiving firmware upgrades transmitted from the remote, network-connected server.

* * * * *

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(12) **United States Patent**
Koss et al.

(10) **Patent No.: US 10,206,025 B2**
(45) **Date of Patent: *Feb. 12, 2019**

(54) **SYSTEM WITH WIRELESS EARPHONES**

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(72) Inventors: **Michael J. Koss**, Milwaukee, WI (US); **Michael J. Pelland**, Princeton, WI (US); **Michael Sagan**, Fairfield, CA (US); **Steven R. Reckamp**, Crystal Lake, IL (US); **Gregory J. Hallingstad**, Deforest, WI (US); **Jeffery K. Bovee**, Sterling, IL (US); **Morgan J. Lowery**, Deforest, WI (US)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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H04R 1/10 (2006.01)
H04M 1/02 (2006.01)
(Continued)

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CPC ***H04R 1/1041*** (2013.01); ***H03G 3/02*** (2013.01); ***H03K 17/9622*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H04R 5/033; H04W 92/18
(Continued)

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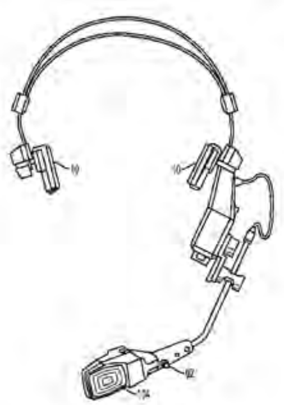
(57) **ABSTRACT**

Apparatus comprises adapter and speaker system. Adapter is configured to plug into port of personal digital audio player. Speaker system is in communication with adapter, and comprises multiple acoustic transducers, programmable processor circuit, and wireless communication circuit. In first operational mode, processor circuit receives, via adapter, and processes digital audio content from personal digital audio player into which adapter is plugged, and the multiple acoustic transducers output the received audio content from the personal digital audio player. In second operational mode, wireless communication circuit receives digital audio content from a remote digital audio source over a wireless network, processor circuit processes the digital audio content received from remote digital audio source, and the multiple acoustic transducers output the audio content received from the remote digital audio source.

56 Claims, 16 Drawing Sheets



Bose Exhibit 1001
Bose v. Koss

Related U.S. Application Data

continuation of application No. 15/293,785, filed on Oct. 14, 2016, now Pat. No. 9,729,959, which is a continuation of application No. 15/082,040, filed on Mar. 28, 2016, now Pat. No. 9,497,535, which is a continuation of application No. 14/695,696, filed on Apr. 24, 2015, now Pat. No. 9,438,987, which is a continuation of application No. 13/609,409, filed on Sep. 11, 2012, now Pat. No. 9,049,502, which is a continuation of application No. 13/459,291, filed on Apr. 30, 2012, now Pat. No. 8,571,544, which is a continuation of application No. 12/936,488, filed as application No. PCT/US2009/039754 on Apr. 7, 2009, now Pat. No. 8,190,203.

(60) Provisional application No. 61/123,265, filed on Apr. 7, 2008.

(51) **Int. Cl.**

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H04R 5/033	(2006.01)
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H04W 48/20	(2009.01)
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H04W 4/80	(2018.01)
H04R 25/00	(2006.01)
H04W 84/18	(2009.01)
H04W 84/12	(2009.01)

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CPC ***H04H 20/95*** (2013.01); ***H04L 61/6068*** (2013.01); ***H04M 1/0254*** (2013.01); ***H04R 1/02*** (2013.01); ***H04R 1/1091*** (2013.01); ***H04R 3/00*** (2013.01); ***H04R 5/033*** (2013.01); ***H04R 5/04*** (2013.01); ***H04W 4/80*** (2018.02); ***H04W 48/20*** (2013.01); *H03K 2217/960785* (2013.01); *H04R 25/554* (2013.01); *H04R 2201/103* (2013.01); *H04R 2201/107* (2013.01); *H04R 2225/55* (2013.01); *H04R 2420/07* (2013.01); *H04W 84/12* (2013.01); *H04W 84/18* (2013.01)

(58) **Field of Classification Search**
USPC 455/456.1, 41.2, 3.05, 573; 381/301, 381/380, 74, 151
See application file for complete search history.

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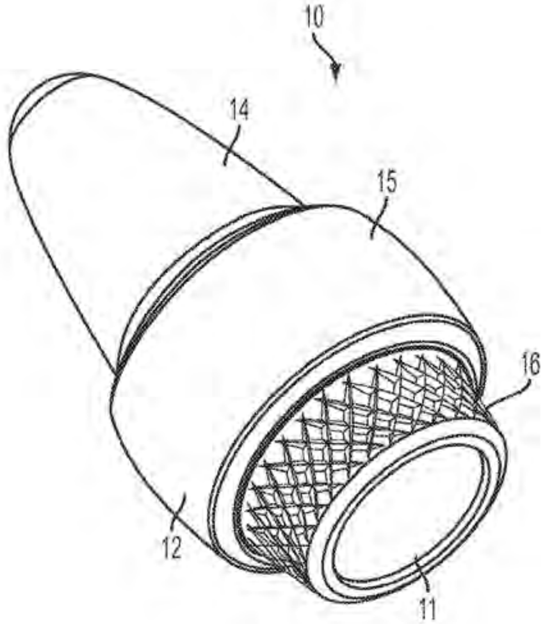


FIG. 1A

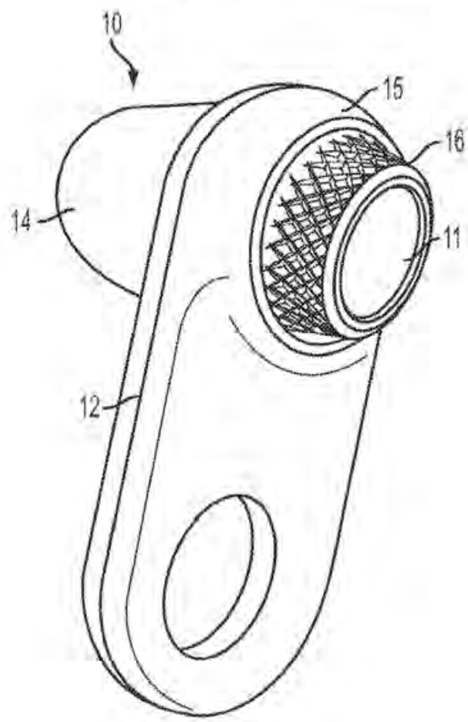


FIG. 1B

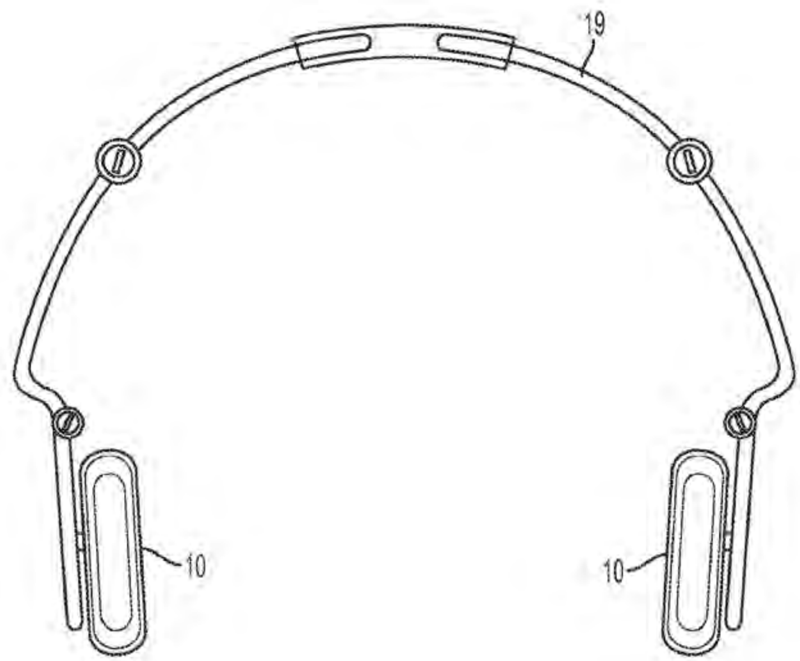


FIG. 1C

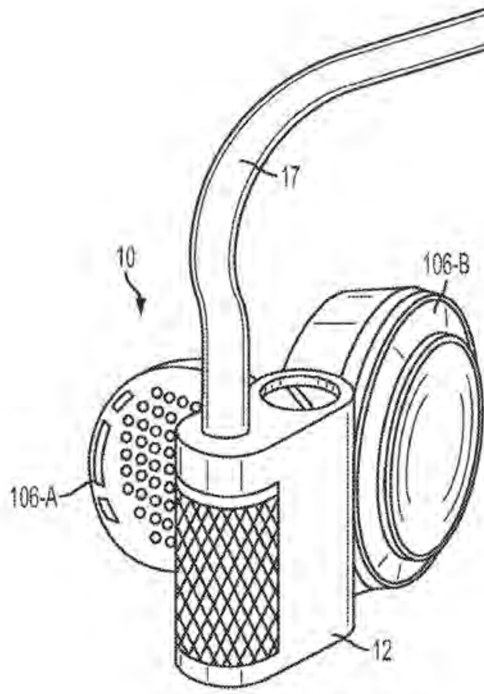


FIG. 1D

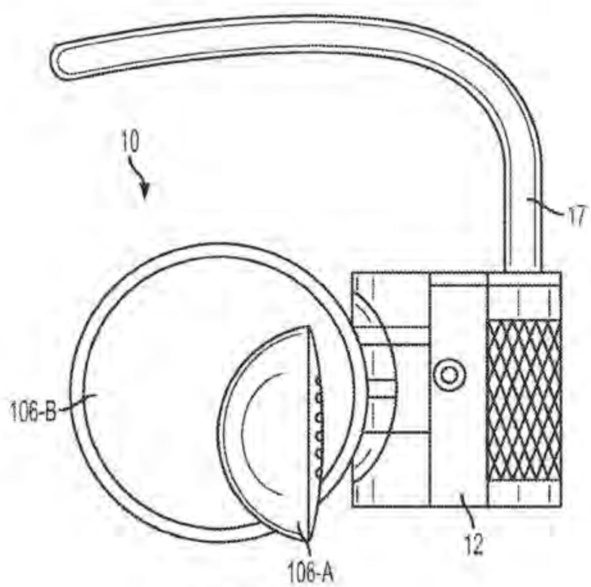


FIG. 1E

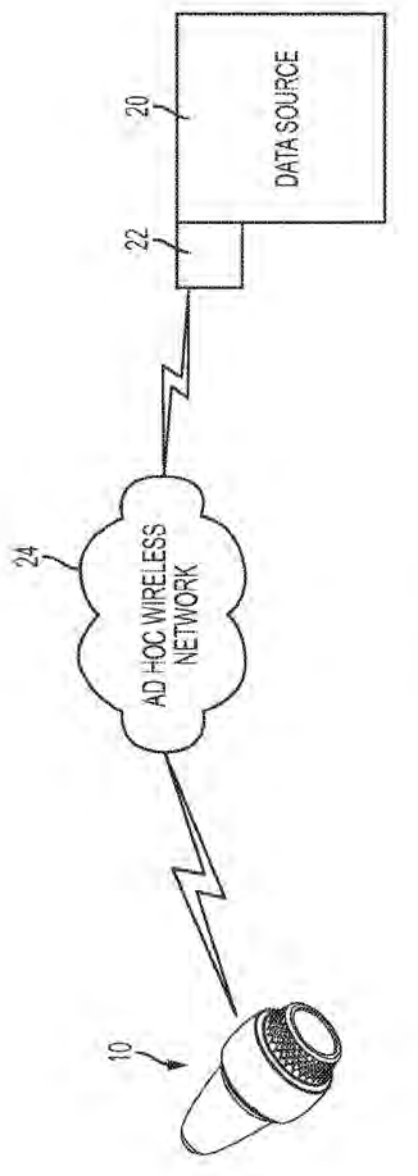


FIG. 2A

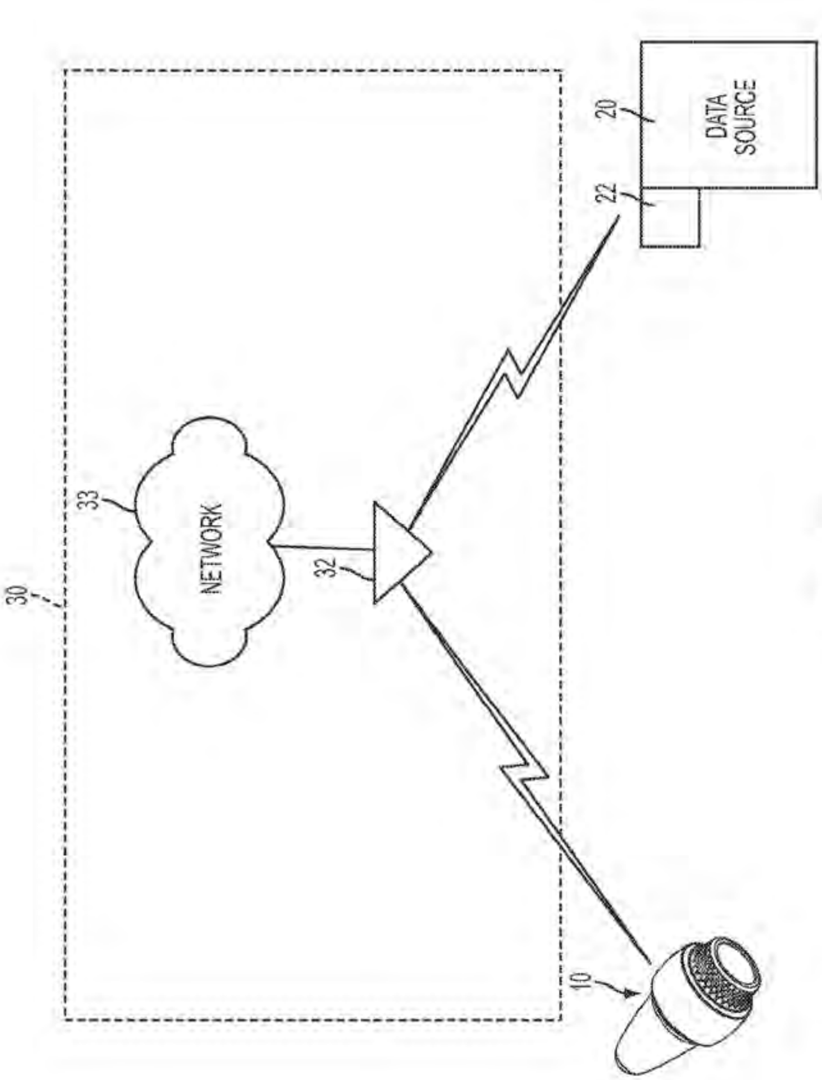


FIG. 2B

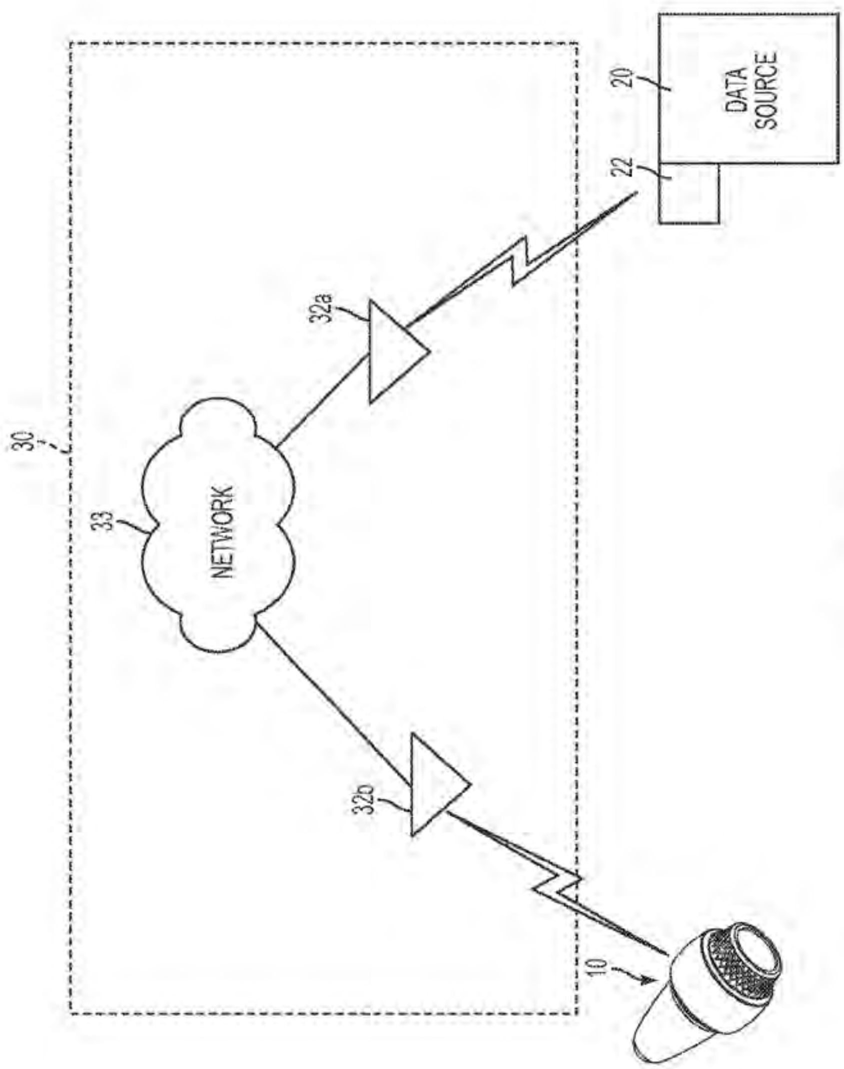
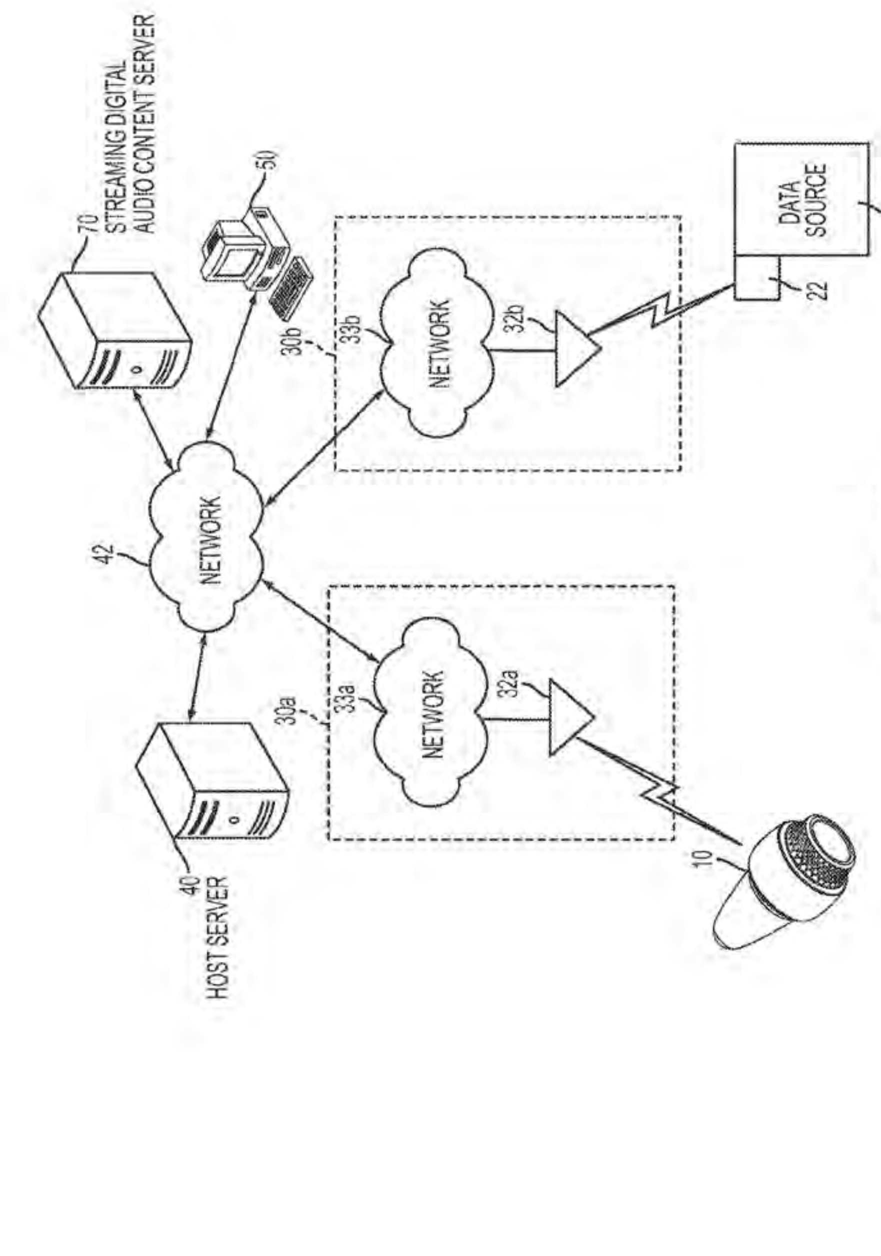


FIG. 2C



70
STREAMING DIGITAL
AUDIO CONTENT SERVER
50
42
NETWORK
30b
33b
NETWORK
32b
DATA
SOURCE
20
22
40
HOST SERVER
30a
33a
NETWORK
32a
10

FIG. 2D

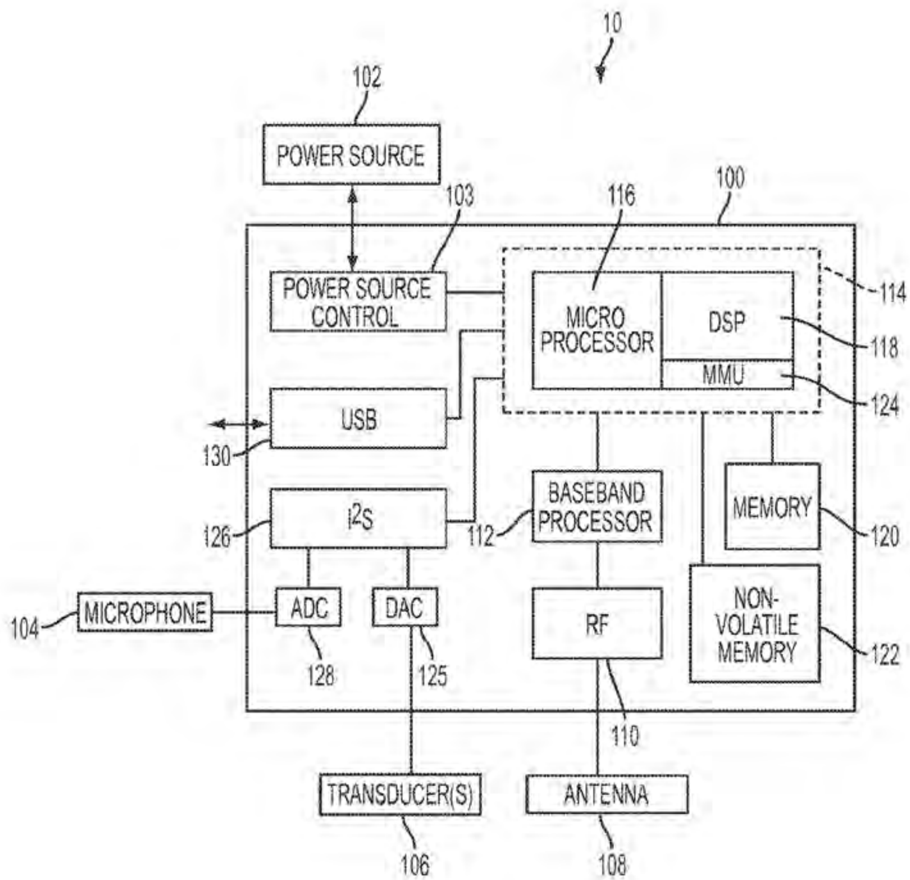

10
102
POWER SOURCE
103
116
100
POWER SOURCE CONTROL
MICRO PROCESSOR
DSP
MMU
114
118
124
USB
130
i2S
126
BASEBAND PROCESSOR
112
MEMORY
120
MICROPHONE
104
ADC
DAC
128
125
RF
NON-VOLATILE MEMORY
122
110
TRANSDUCER(S)
ANTENNA
106
108

FIG. 3

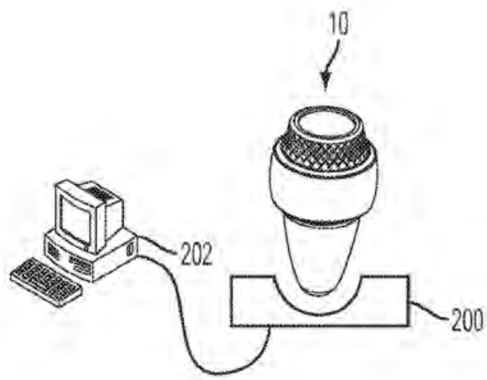


FIG. 4A

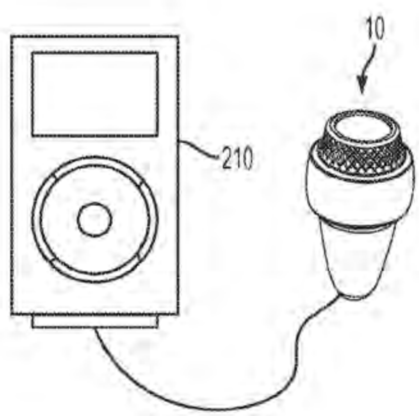


FIG. 4B

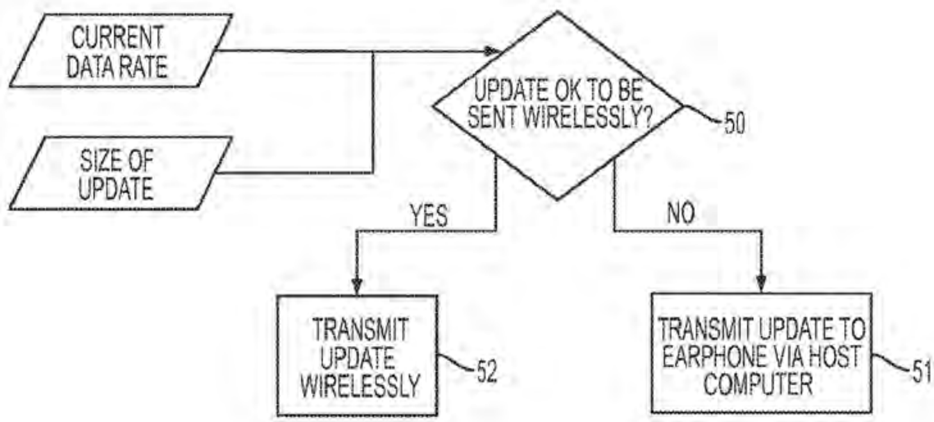

CURRENT DATA RATE
SIZE OF UPDATE
UPDATE OK TO BE SENT WIRELESSLY?
50
YES
NO
TRANSMIT UPDATE WIRELESSLY
52
TRANSMIT UPDATE TO EARPHONE VIA HOST COMPUTER
51

FIG. 5

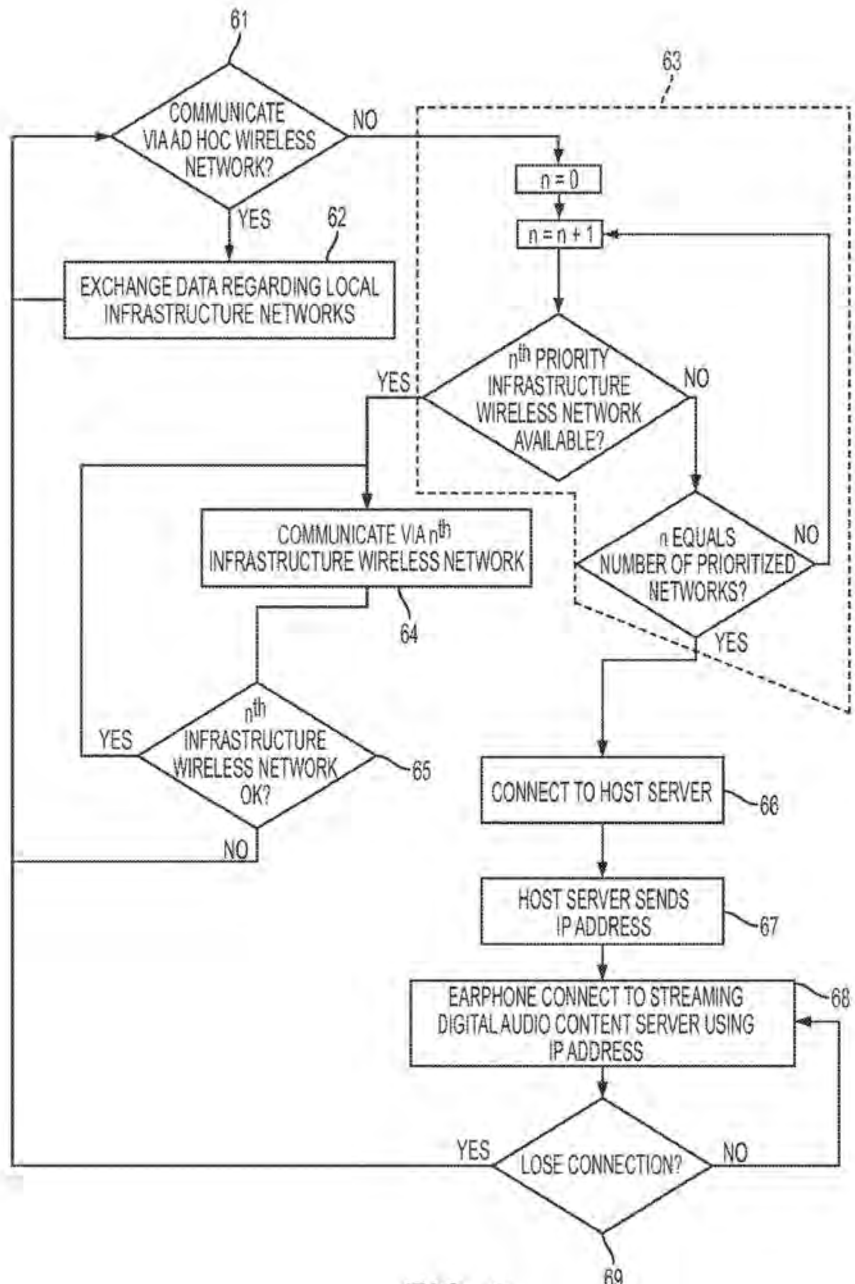

61
COMMUNICATE VIA AD HOC WIRELESS NETWORK?
NO
YES
62
EXCHANGE DATA REGARDING LOCAL INFRASTRUCTURE NETWORKS
63
n = 0
n = n + 1
n^th PRIORITY INFRASTRUCTURE WIRELESS NETWORK AVAILABLE?
YES
NO
COMMUNICATE VIA n^th INFRASTRUCTURE WIRELESS NETWORK
64
n EQUALS NUMBER OF PRIORITIZED NETWORKS?
NO
YES
n^th INFRASTRUCTURE WIRELESS NETWORK OK?
YES
NO
65
CONNECT TO HOST SERVER
66
HOST SERVER SENDS IP ADDRESS
67
EARPHONE CONNECT TO STREAMING DIGITAL AUDIO CONTENT SERVER USING IP ADDRESS
68
LOSE CONNECTION?
YES
NO
69

FIG. 6

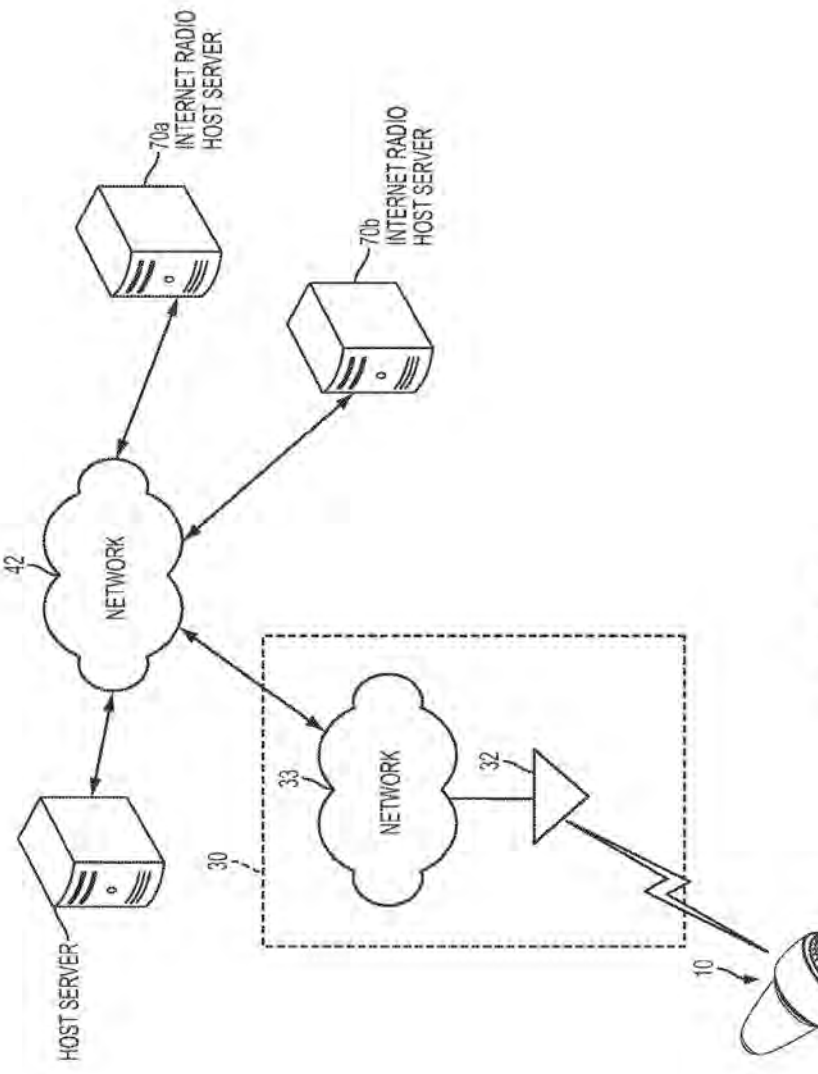

70a
INTERNET RADIO
HOST SERVER
70b
INTERNET RADIO
HOST SERVER
42
NETWORK
33
NETWORK
32
30
HOST SERVER
10

FIG. 7

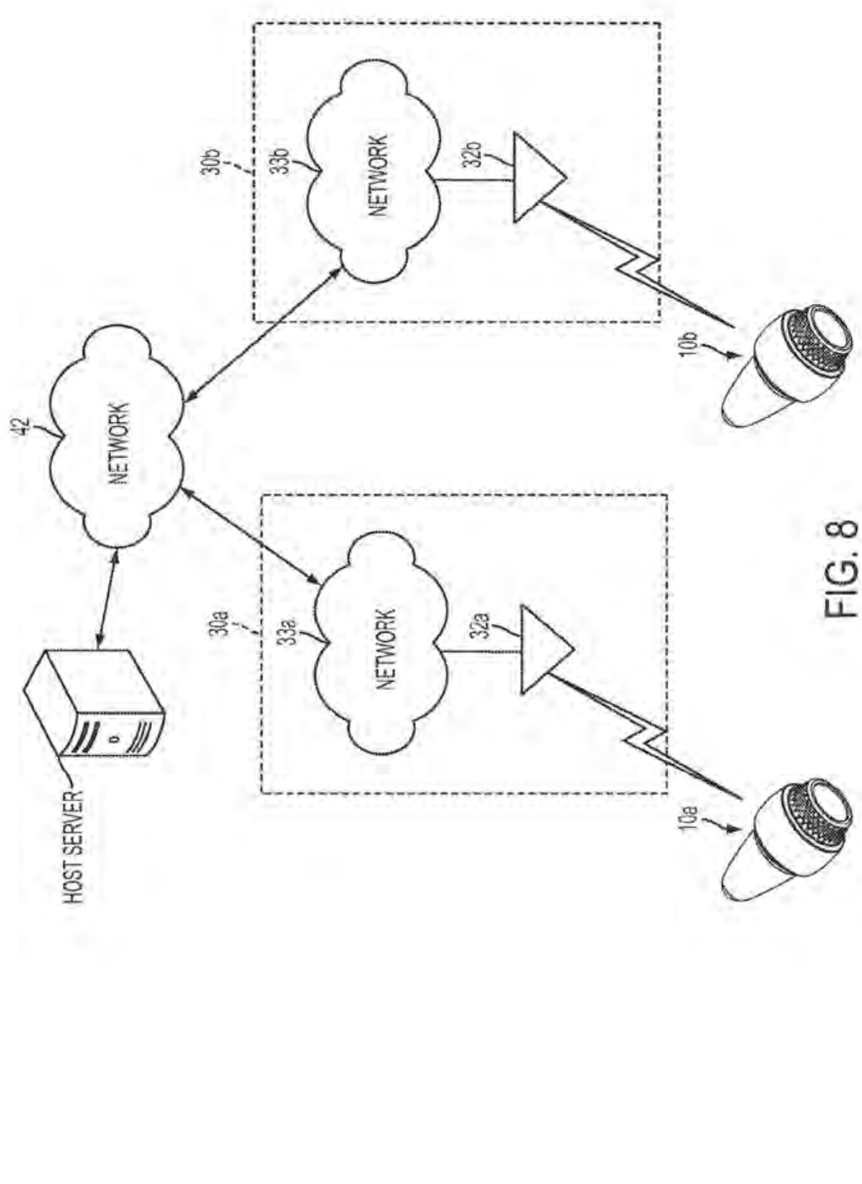

HOST SERVER
42
NETWORK
30b
33b
NETWORK
32b
10b
30a
33a
NETWORK
32a
10a

FIG. 8

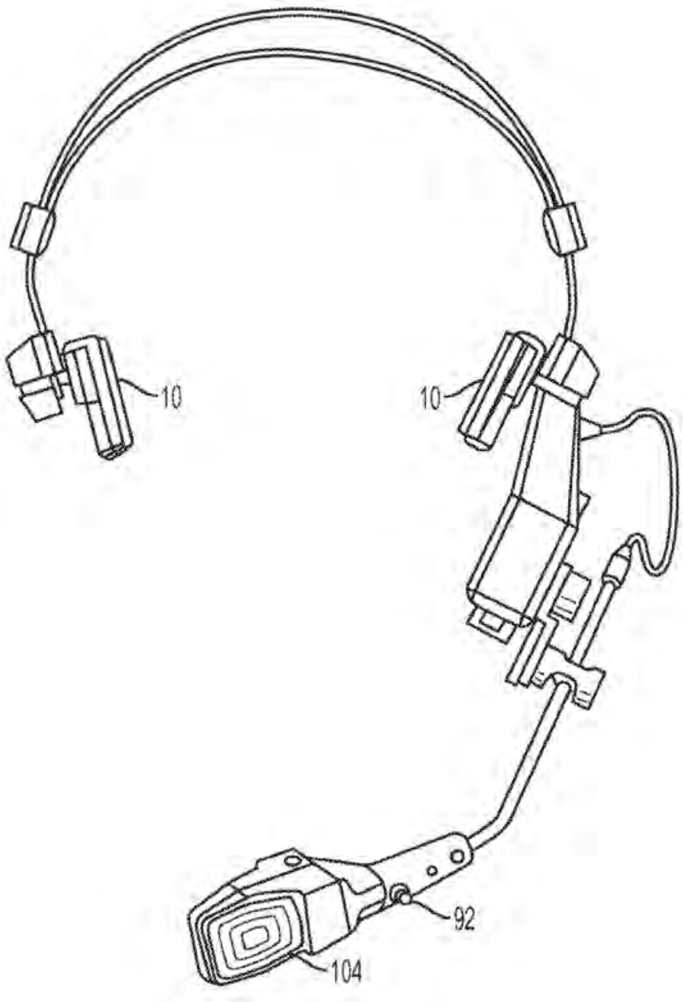


FIG. 9

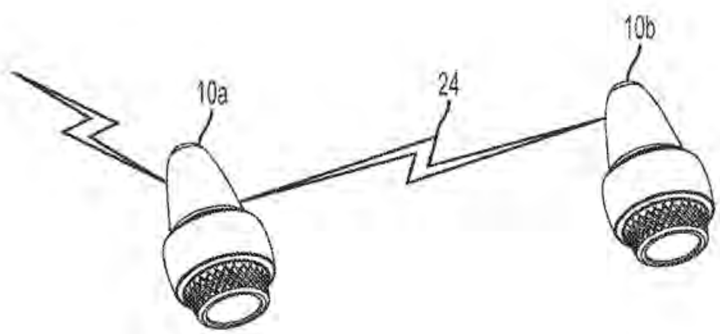


FIG. 10

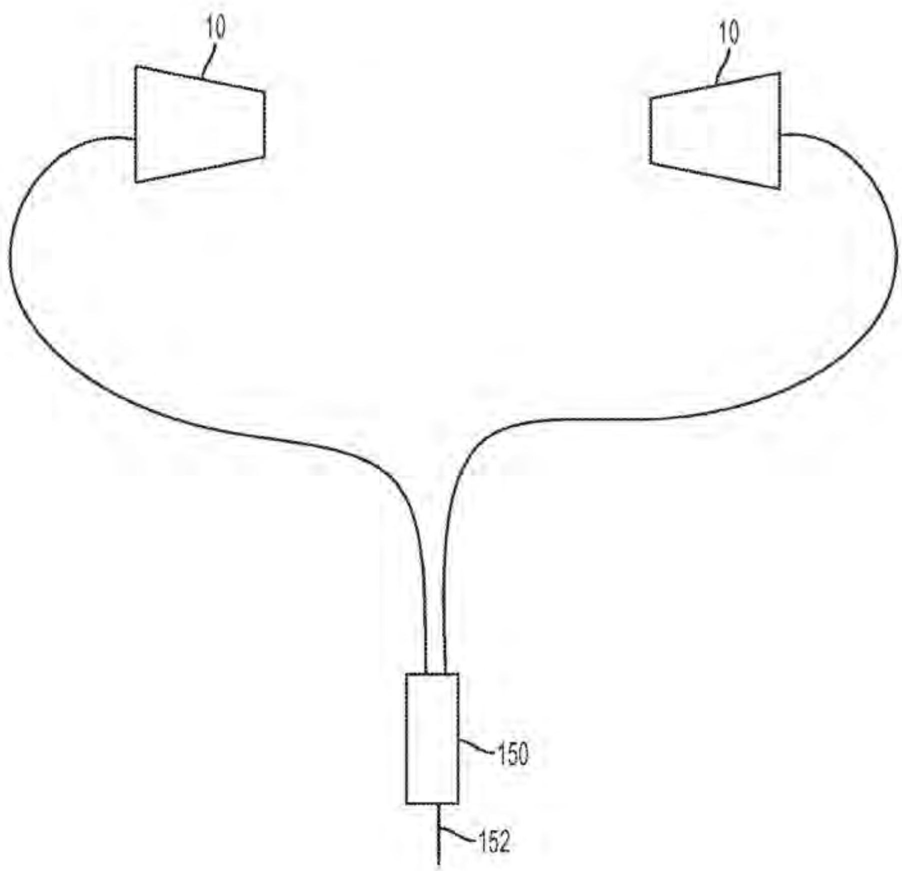


FIG. 11

SYSTEM WITH WIRELESS EARPHONES

PRIORITY CLAIM

The present application claims priority as a continuation to U.S. nonprovisional patent application Ser. No. 15/650,362, filed Jul. 14, 2017, now U.S. Pat. No. 9,986,325, issued May 29, 2018, which is a continuation of U.S. nonprovisional patent application Ser. No. 15/293,785, filed Oct. 14, 2016, now U.S. Pat. No. 9,729,959, issued Aug. 8, 2017, which is a continuation of U.S. nonprovisional patent application Ser. No. 15/082,040, filed Mar. 28, 2016, now U.S. Pat. No. 9,497,535, issued Nov. 15, 2016, which is a continuation of U.S. nonprovisional patent application Ser. No. 14/695,696, filed Apr. 24, 2015, now U.S. Pat. No. 9,438,987, issued on Sep. 6, 2016, which is a continuation of U.S. nonprovisional patent application Ser. No. 13/609,409, filed Sep. 11, 2012, now U.S. Pat. No. 9,049,502, issued Jun. 2, 2015, which is a continuation of U.S. nonprovisional patent application Ser. No. 13/459,291, filed Apr. 30, 2012, now U.S. Pat. No. 8,571,544, issued Oct. 29, 2013, which is a continuation of U.S. patent application Ser. No. 12/936,488, filed Dec. 20, 2010, now U.S. Pat. No. 8,190,203, issued May 29, 2012, which is a national stage entry of PCT/US2009/039754, filed Apr. 7, 2009, which claims priority to U.S. provisional patent application Ser. No. 61/123,265, filed Apr. 7, 2008, all of which are incorporated herein by reference in their entireties.

CROSS-REFERENCE TO RELATED APPLICATIONS

U.S. nonprovisional patent application Ser. No. 14/031,938, filed Sep. 13, 2013, now U.S. Pat. No. 8,655,420, issued Feb. 18, 2014, is also a continuation of U.S. nonprovisional patent application Ser. No. 13/609,409, filed Sep. 11, 2012, now U.S. Pat. No. 9,049,502, mentioned above.

BACKGROUND

Digital audio players, such as MP3 players and iPods, that store and play digital audio files, are very popular. Such devices typically comprise a data storage unit for storing and playing the digital audio, and a headphone set that connects to the data storage unit, usually with a ¼" or a 3.5 mm jack and associated cord. Often the headphones are in-ear type headphones. The cord, however, between the headphones and the data storage unit can be cumbersome and annoying to users, and the length of the cord limits the physical distance between the data storage unit and the headphones. Accordingly, some cordless headphones have been proposed, such as the Monster iFreePlay cordless headphones from Apple Inc., which include a docking port on one of the earphones that can connect directly to an iPod Shuffle. Because they have the docking port, however, the Monster iFreePlay cordless headphones from Apple are quite large and are not in-ear type phones. Recently, cordless headphones that connect wirelessly via IEEE 802.11 to a WLAN-ready laptop or personal computer (PC) have been proposed, but such headphones are also quite large and not in-ear type phones.

SUMMARY

In one general aspect, the present invention is directed to a wireless earphone that comprises a transceiver circuit for receiving streaming audio from a data source, such as a digital audio player or a computer, over an ad hoc wireless network. When the data source and the earphone are out of range via the ad hoc wireless network, they may transition automatically to a common infrastructure wireless network (e.g., a wireless LAN). If there is no common infrastructure wireless network for both the data source and the earphone, the earphone may connect via an available infrastructure wireless network to a host server. The host server may, for example, broadcast streaming audio to the earphone and/or transmit to the earphone a network address (e.g., an Internet Protocol (IP) address) for a network-connected content server that streams digital audio. The earphone may then connect to the content server using the IP address. The content server may be an Internet radio server, including, for example, an Internet radio server that broadcasts streaming audio from the data source or some other content.

These and other advantageous, unique aspects of the wireless earphone are described below.

FIGURES

Various embodiments of the present invention are described herein by way of example in conjunction with the following figures, wherein:

FIGS. **1**A-**1**E are views of a wireless earphone according to various embodiments of the present invention;

FIGS. **2**A-**2**D illustrate various communication modes for a wireless earphone according to various embodiments of the present invention;

FIG. **3** is a block diagram of a wireless earphone according to various embodiments of the present invention;

FIGS. **4**A-**4**B show the wireless earphone connected to another device according to various embodiments of the present invention;

FIG. **5** is a diagram of a process implemented by a host server according to various embodiments of the present invention;

FIG. **6** is a diagram of a process implemented by the wireless earphone to transition automatically between wireless networks according to various embodiments of the present invention;

FIGS. **7**, **8** and **10** illustrate communication systems involving the wireless earphone according to various embodiments of the present invention;

FIG. **9** is a diagram of a headset including a wireless earphone and a microphone according to various embodiments of the present invention; and

FIG. **11** is a diagram of a pair of wireless earphones with a dongle according to various embodiments of the present invention.

DESCRIPTION

In one general aspect, the present invention is directed to a wireless earphone that receives streaming audio data via ad hoc wireless networks and infrastructure wireless networks, and that transitions seamlessly between wireless networks. The earphone may comprise one or more in-ear, on-ear, or over-ear speaker elements. Two exemplary in-ear earphone shapes for the wireless earphone **10** are shown in FIGS. **1**A and **1**B, respectively, although in other embodiments the earphone may take different shapes and the exemplary shapes shown in FIGS. **1**A and **1**B are not intended to be limiting. In one embodiment, the earphone transitions automatically and seamlessly, without user intervention, between communication modes. That is, the earphone may transition automatically from an ad hoc wireless network to

an infrastructure wireless network, without user intervention. As used herein, an "ad hoc wireless network" is a network where two (or more) wireless-capable devices, such as the earphone and a data source, communicate directly and wirelessly, without using an access point. An "infrastructure wireless network," on the other hand, is a wireless network that uses one or more access points to allow a wireless-capable device, such as the wireless earphone, to connect to a computer network, such as a LAN or WAN (including the Internet).

FIGS. **1A** and **1B** show example configurations for a wireless earphone **10** according to various embodiments of the present invention. The examples shown in FIGS. **1A** and **1B** are not limiting and other configurations are within the scope of the present invention. As shown in FIGS. **1A** and **1B**, the earphone **10** may comprise a body **12**. The body **12** may comprise an ear canal portion **14** that is inserted in the ear canal of the user of the earphone **10**. In various embodiments, the body **12** also may comprise an exterior portion **15** that is not inserted into user's ear canal. The exterior portion **15** may comprise a knob **16** or some other user control (such as a dial, a pressure-activated switch, lever, etc.) for adjusting the shape of the ear canal portion **14**. That is, in various embodiments, activation (e.g. rotation) of the knob **16** may cause the ear canal portion **14** to change shape so as to, for example, radially expand to fit snugly against all sides of the user's ear canal. Further details regarding such a shape-changing earbud earphone are described in application PCT/US08/88656, filed 31 Dec. 2008, entitled "Adjustable Shape Earphone," which is incorporated herein by reference in its entirety. The earphone **10** also may comprise a transceiver circuit housed within the body **12**. The transceiver circuit, described further below, may transmit and receive the wireless signals, including receive streaming audio for playing by the earphone **10**. The transceiver circuit may be housed in the exterior portion **15** of the earphone **10** and/or in the ear canal portion **14**.

Although the example earphones **10** shown in FIGS. **1A** and **1B** include a knob **16** for adjusting the shape of the ear canal portion **14**, the present invention is not so limited, and in other embodiments, different means besides a knob **16** may be used to adjust the ear canal portion **14**. In addition, in other embodiments, the earphone **10** may not comprise a shape-changing ear canal portion **14**.

In various embodiments, the user may wear two discrete wireless earphones **10**: one in each ear. In such embodiments, each earphone **10** may comprise a transceiver circuit. In such embodiments, the earphones **10** may be connected by a string or some other cord-type connector to keep the earphones **10** from being separated.

In other embodiments, as shown in FIG. **1C**, a headband **19** may connect the two (left and right) earphones **10**. The headband **19** may be an over-the-head band, as shown in the example of FIG. **1C**, or the headband may be a behind-the-head band. In embodiments comprising a headband **19**, each earphone **10** may comprise a transceiver circuit; hence, each earphone **10** may receive and transmit separately the wireless communication signals. In other embodiments comprising a headband **19**, only one earphone **10** may comprise the transceiver circuit, and a wire may run along the headband **19** to the other earphone **10** to connect thereby the transceiver circuit to the acoustic transducer in the earphone that does not comprise the transceiver circuit. The embodiment shown in FIG. **1C** comprises on-ear earphones **10**; in other embodiments, in-ear or over-ear earphones may be used.

In other embodiments, the earphone **10** may comprise a hanger bar **17** that allows the earphone **10** to clip to, or hang on, the user's ear, as shown in the illustrated embodiment of FIGS. **1D-1E**. FIG. **1D** is a perspective view of the earphone and FIG. **1E** is a side view according to one embodiment. As shown in the illustrated embodiment, the earphone **10** may comprise dual speaker elements **106-A**, **106-B**. One of the speaker elements (the smaller one) **106-A** is sized to fit into the cavum concha of the listener's ear and the other element (the larger one) **106-B** is not. The listener may use the hanger bar to position the earphone on the listener's ear. In that connection, the hanger bar may comprise a horizontal section that rests upon the upper external curvature of the listener's ear behind the upper portion of the auricula (or pinna). The earphone may comprise a knurled knob that allows the user to adjust finely the distance between the horizontal section of the hanger bar and the speaker elements, thereby providing, in such embodiments, another measure of adjustability for the user. More details regarding such a dual element, adjustable earphone may be found in U.S. provisional patent application Ser. No. 61/054,238, which is incorporated herein by reference in its entirety.

FIGS. **2A-2D** illustrate various communication modes for a wireless data communication system involving the earphone **10** according to embodiments of the present invention. As shown in FIG. **2A**, the system comprises a data source **20** in communication with the earphone **10** via an ad hoc wireless network **24**. The earphone **10**, via its transceiver circuit (described in more detail below), may communicate wirelessly with a data source **20**, which may comprise a wireless network adapter **22** for transmitting the digital audio wirelessly. For example, the data source **20** may be a digital audio player (DAP), such as an mp3 player or an iPod, or any other suitable digital audio playing device, such as a laptop or personal computer, that stores and/or plays digital audio files. In other embodiments, the data source **20** may generate analog audio, and the wireless network adapter **22** may encode the analog audio into digital format for transmission to the earphone **10**.

The wireless network adapter **22** may be an integral part of the data source **20**, or it may be a separate device that is connected to the data source **20** to provide wireless connectivity for the data source **20**. For example, the wireless network adapter **22** may comprise a wireless network interface card (WNIC) or other suitable transceiver that plugs into a USB port or other port or jack of the data source **20** (such as a TRS connector) to stream data, e.g., digital audio files, via a wireless network (e.g., the ad hoc wireless network **24** or an infrastructure wireless network). The digital audio transmitted from the data source **20** to the earphone **10** via the wireless networks may comprise compressed or uncompressed audio. Any suitable file format may be used for the audio, including mp3, lossy or lossless WMA, Vorbis, Musepack, FLAC, WAV, AIFF, AU, or any other suitable file format.

When in range, the data source **20** may communicate with the earphone **10** via the ad hoc wireless network **24** using any suitable wireless communication protocol, including Wi-Fi (e.g., IEEE 802.11a/b/g/n), WiMAX (IEEE 802.16), Bluetooth, Zigbee, UWB, or any other suitable wireless communication protocol. For purposes of the description to follow, it is assumed that the data source **20** and the earphone **10** communicate using a Wi-Fi protocol, although the invention is not so limited and other wireless communication protocols may be used in other embodiments of the invention. The data source **20** and the earphone **10** are considered in range for the ad hoc wireless network **24** when the signal strengths (e.g., the RSSI) of the signals received by the two devices are above a threshold minimum signal strength

level. For example, the data source **20** and the earphone **10** are likely to be in range for an ad hoc wireless network when then are in close proximity, such as when the wearer of the earphone **10** has the data source **20** on his/her person, such as in a pocket, strapped to their waist or arm, or holding the data source in their hand.

When the earphone **10** and the data source **20** are out of range for the ad hoc wireless network **24**, that is, when the received signals degrade below the threshold minimum signal strength level, both the earphone **10** and the data source **20** may transition automatically to communicate over an infrastructure wireless network (such as a wireless LAN (WLAN)) **30** that is in the range of both the earphone **10** and the data source **20**, as shown in FIG. 2B. The earphone **10** and the data source **20** (e.g., the wireless network adapter **22**) may include firmware, as described further below, that cause the components to make the transition to a common infrastructure wireless network **30** automatically and seamlessly, e.g., without user intervention. The earphone **10** may cache the received audio in a buffer or memory for a time period before playing the audio. The cached audio may be played after the connection over the ad hoc wireless network is lost to give the earphone **10** and the data source **20** time to connect via the infrastructure wireless network.

For example, as shown in FIG. 2B, the infrastructure network may comprise an access point **32** that is in the range of both the data source **20** and the earphone **10**. The access point **32** may be an electronic hardware device that acts as a wireless access point for, and that is connected to, a wired and/or wireless data communication network **33**, such as a LAN or WAN, for example. The data source **20** and the earphone **10** may both communicate wirelessly with the access point **32** using the appropriate network data protocol (a Wi-Fi protocol, for example). The data source **20** and the earphone **10** may both transition automatically to an agreed-upon WLAN **30** that is in the range of both devices when they cannot communicate satisfactorily via the ad hoc wireless network **24**. A procedure for specifying an agreed-upon infrastructure wireless network **30** is described further below. Alternatively, the infrastructure wireless network **30** may have multiple access points **32***a-b*, as shown in FIG. 2C. In such an embodiment, the data source **20** may communicate wirelessly with one access point **32***b* and the earphone **10** may communicate wirelessly with another access point **32***a* of the same infrastructure wireless network **30**. Again, the data source **20** and the earphone **10** may transition to an agreed-upon WLAN.

If there is no suitable common infrastructure wireless network over which the earphone **10** and the data source **20** can communicate, as shown in FIG. 2D, the earphone **10** may transition to communicate with an access point **32***a* for an available (first) wireless network (e.g., WLAN) **30***a* that is in the range of the earphone **10**. In this mode, the earphone **10** may connect via the wireless network **30***a* to a network-enabled host server **40**. The host server **40** may be connected to the wireless network **30***a* via an electronic data communication network **42**, such as the Internet. In one mode, the host server **40** may transmit streaming digital audio via the networks **33***a*, **42** to the earphone **10**. In another mode, the host server **40** may transmit to the earphone **10** a network address, such as an Internet Protocol (IP) address, for a streaming digital audio content server **70** on the network **42**. Using the received IP address, the earphone **10** may connect to the streaming digital audio content server **70** via the networks **30***a*, **42** to receive and process digital audio from the streaming digital audio content server **70**.

The digital audio content server **70** may be, for example, an Internet radio station server. The digital audio content server **70** may stream digital audio over the network **42** (e.g., the Internet), which the earphone **10** may receive and process. In one embodiment, the streaming digital audio content server **70** may stream digital audio received by the streaming digital audio content server **70** from the data source **20**. For example, where the data source **20** is a wireless-capable device, such as a portable DAP, the data source **20** may connect to the streaming digital audio content server **70** via a wireless network **30***b* and the network **42**. Alternatively, where for example the data source **20** is non-wireless-capable device, such as a PC, the data source **20** may have a direct wired connection to the network **42**. After being authenticated by the streaming digital audio content server **70**, the data source **20** may stream digital audio to the streaming digital audio content server **70**, which may broadcast the received digital audio over the network **42** (e.g., the Internet). In such a manner, the user of the earphone **10** may listen to audio from the data source **20** even when (i) the earphone **10** and the data source **20** are not in communication via an ad hoc wireless network **24** and (ii) the earphone **10** and the data source **20** are not in communication via a common local infrastructure wireless network **30**.

FIG. **3** is a block diagram of the earphone **10** according to various embodiments of the present invention. In the illustrated embodiment, the earphone **10** comprises a transceiver circuit **100** and related peripheral components. As shown in FIG. **3**, the peripheral components of the earphone **10** may comprise a power source **102**, a microphone **104**, one or more acoustic transducers **106** (e.g., speakers), and an antenna **108**. The transceiver circuit **100** and some of the peripheral components (such as the power source **102** and the acoustic transducers **106**) may be housed within the body **12** of the earphone **10** (see FIG. **1**). Other peripheral components, such as the microphone **104** and the antenna **108** may be external to the body **12** of the earphone **10**. In addition, some of the peripheral components, such as the microphone **104**, are optional in various embodiments.

In various embodiments, the transceiver circuit **100** may be implemented as a single integrated circuit (IC), such as a system-on-chip (SoC), which is conducive to miniaturizing the components of the earphone **10**, which is advantageous if the earphone **10** is to be relatively small in size, such as an in-ear earphone (see FIGS. **1A-1B** for example). In alternative embodiments, however, the components of the transceiver circuit **100** could be realized with two or more discrete ICs or other components, such as separate ICs for the processors, memory, and RF (e.g., Wi-Fi) module, for example.

The power source **102** may comprise, for example, a rechargeable or non-rechargeable battery (or batteries). In other embodiments, the power source **102** may comprise one or more ultracapacitors (sometimes referred to as supercapacitors) that are charged by a primary power source. In embodiments where the power source **102** comprises a rechargeable battery cell or an ultracapacitor, the battery cell or ultracapacitor, as the case may be, may be charged for use, for example, when the earphone **10** is connected to a docking station or computer. The docking station may be connected to or part of a computer device, such as a laptop computer or PC. In addition to charging the rechargeable power source **102**, the docking station and/or computer may facilitate downloading of data to and/or from the earphone **10**. In other embodiments, the power source **102** may comprise capacitors passively charged with RF radiation,

such as described in U.S. Pat. No. 7,027,311. The power source **102** may be coupled to a power source control module **103** of transceiver circuit **100** that controls and monitors the power source **102**.

The acoustic transducer(s) **106** may be the speaker element(s) for conveying the sound to the user of the earphone **10**. According to various embodiments, the earphone **10** may comprise one or more acoustic transducers **106**. For embodiments having more than one transducer, one transducer may be larger than the other transducer, and a crossover circuit (not shown) may transmit the higher frequencies to the smaller transducer and may transmit the lower frequencies to the larger transducer. More details regarding dual element earphones are provided in U.S. Pat. No. 5,333,206, assigned to Koss Corporation, which is incorporated herein by reference in its entirety.

The antenna **108** may receive and transmit the wireless signals from and to the wireless networks **24**, **30**. A RF (e.g., Wi-Fi) module **110** of the transceiver circuit **100** in communication with the antenna **108** may, among other things, modulate and demodulate the signals transmitted from and received by the antenna **108**. The RF module **110** communicates with a baseband processor **112**, which performs other functions necessary for the earphone **10** to communicate using the Wi-Fi (or other communication) protocol.

The baseband processor **112** may be in communication with a processor unit **114**, which may comprise a microprocessor **116** and a digital signal processor (DSP) **118**. The microprocessor **116** may control the various components of the transceiver circuit **100**. The DSP **114** may, for example, perform various sound quality enhancements to the digital audio received by the baseband processor **112**, including noise cancellation and sound equalization. The processor unit **114** may be in communication with a volatile memory unit **120** and a non-volatile memory unit **122**. A memory management unit **124** may control the processor unit's access to the memory units **120**, **122**. The volatile memory **122** may comprise, for example, a random access memory (RAM) circuit. The non-volatile memory unit **122** may comprise a read only memory (ROM) and/or flash memory circuits. The memory units **120**, **122** may store firmware that is executed by the processor unit **114**. Execution of the firmware by the processor unit **114** may provide various functionality for the earphone **10**, such as the automatic transition between wireless networks as described herein. The memory units **120**, **122** may also cache received digital audio.

A digital-to-analog converter (DAC) **125** may convert the digital audio from the processor unit **114** to analog form for coupling to the acoustic transducer(s) **106**. An I^2S interface **126** or other suitable serial or parallel bus interface may provide the interface between the processor unit **114** and the DAC **125**. An analog-to-digital converter (ADC) **128**, which also communicates with the I^2S interface **126**, may convert analog audio signals picked up by the microphone **104** for processing by the processor unit **114**.

The transceiver circuit **100** also may comprise a USB or other suitable interface **130** that allows the earphone **10** to be connected to an external device via a USB cable or other suitable link. As shown in FIG. **4A**, the external device may be a docking station **200** connected to a computer device **202**. Also, in various embodiments, the earphone **10** could be connected directly to the computer **202** without the docking station **200**. In addition, the external device may be a DAP **210**, as shown in FIG. **4B**. In that way, the earphone **10** could connect directly to a data source **20**, such as the DAP **210** or the computer **202**, through the USB port **130**.

In addition, through the USB port **130**, the earphone **10** may connect to a PC **202** or docking station **202** to charge up the power source **102** and/or to get downloads (e.g., data or firmware).

According to various embodiments, the earphone **10** may have an associated web page that a user may access through the host server **40** (see FIG. **2D**) or some other server. An authenticated user could log onto the website from a client computing device **50** (e.g., laptop, PC, handheld computer device, etc., including the data source **20**) (see FIG. **2D**) to access the web page for the earphone **10** to set various profile values for the earphone **10**. For example, at the web site, the user could set various content features and filters, as well as adjust various sound control features, such as treble, bass, frequency settings, noise cancellation settings, etc. In addition, the user could set preferred streaming audio stations, such as preferred Internet radio stations or other streaming audio broadcasts. That way, instead of listening to streaming audio from the data source **20**, the user could listen to Internet radio stations or other streaming audio broadcasts received by the earphone **10**. In such an operating mode, the earphone user, via the web site, may prioritize a number of Internet radio stations or other broadcast sources (hosted by streaming digital audio content servers **70**). With reference to FIG. **7**, the host server **40** may send the IP address for the earphone user's desired (e.g., highest priority) Internet radio station to the earphone **10**. A button **11** on the earphone **10**, such as on the rotating dial **16** as shown in the examples of FIGS. **1A** and **1B**, may allow the user to cycle through the preset preferred Internet radio stations. That is, for example, when the user presses the button **11**, an electronic communication may be transmitted to the host server **40** via the wireless network **30**, and in response to receiving the communication, the host server **40** may send the IP address for the user's next highest rated Internet radio station via the network **42** to the earphone **10**. The earphone **10** may then connect to the streaming digital audio content server **70** for that Internet radio station using the IP address provided by the host server **40**. This process may be repeated, e.g., cycled through, for each preset Internet radio station configured by the user of the earphone **10**.

At the web site for the earphone **10** hosted on the host server **40**, in addition to establishing the identification of digital audio sources (e.g., IDs for the user's DAP or PC) and earphones, the user could set parental or other user controls. For example, the user could restrict certain Internet radio broadcasts based on content or parental ratings, etc. That is, for example, the user could configure a setting through the web site that prevents the host server **40** from sending an IP address for a streaming digital audio content server **70** that broadcasts explicit content based on a rating for the content. In addition, if a number of different earphones **10** are registered to the same user, the user could define separate controls for the different earphones **10** (as well as customize any other preferences or settings particular to the earphones **10**, including Internet radio stations, sound quality settings, etc. that would later be downloaded to the earphones **10**). In addition, in modes where the host server **40** streams audio to the earphone **10**, the host server **40** may log the files or content streamed to the various earphones **10**, and the user could view at the web site the files or content that were played by the earphones **10**. In that way, the user could monitor the files played by the earphones **10**.

In addition, the host server **40** may provide a so-called eavesdropping function according to various embodiments. The eavesdropping service could be activated via the web

site. When the service is activated, the host server **40** may transmit the content that it is delivering to a first earphone **10***a* to another, second earphone **10***b*, as shown in FIG. **8**. Alternatively, the host server **40** may transmit to the second earphone **10***b* the most recent IP address for a streaming digital audio content server **70** that was sent to the first earphone **10***a*. The second earphone **10***b* may then connect to the streaming digital audio content server **70** that the first earphone **10***a* is currently connected. That way, the user of the second earphone **10***b*, which may be a parent, for example, may directly monitor the content being received by the first earphone **10***a*, which may belong to a child of the parent.

This function also could be present in the earphones **10** themselves, allowing a parent (or other user) to join an ad-hoc wireless network and listen to what their child (or other listener) is hearing. For example, with reference to FIG. **10**, a first earphone **10***a* may receive wireless audio, such as from the data source **20** or some other source, such as the host server **40**. The first earphone **10***a* may be programmed with firmware to broadcast the received audio to a second earphone **10***b* via an ad hoc wireless network **24**. That way, the wearer of the second earphone **10***b* can monitor in real-time the content being played by the first earphone **10***a*.

At the web site, the user may also specify the identification number ("ID") of their earphone(s) **10**, and the host server **40** may translate the ID to the current internet protocol (IP) addresses for the earphone **10** and for the data source **20**. This allows the user to find his or her data source **20** even when it is behind a firewall or on a changing IP address. That way, the host server **40** can match the audio from the data source **20** to the appropriate earphone **10** based on the specified device ID. The user also could specify a number of different data sources **20**. For example, the user's DAP may have one specified IP address and the user's home (or work) computer may have another specified IP address. Via the web site hosted by the host server **40**, the user could specify or prioritize from which source (e.g., the user's DAP or computer) the earphone **10** is to receive content.

The host server **40** (or some other server) may also push firmware upgrades and/or data updates to the earphone **10** using the IP addresses of the earphone **10** via the networks **30**, **42**. In addition, a user could download the firmware upgrades and/or data updates from the host server **40** to the client computing device **202** (see FIG. **4**A) via the Internet, and then download the firmware upgrades and/or data updates to the earphone **10** when the earphone **10** is connected to the client computer device **202** (such as through a USB port and/or the docking station **200**).

Whether the downloads are transmitted wirelessly to the earphone **10** or via the client computing device **202** may depend on the current data rate of the earphone **10** and the quantity of data to be transmitted to the earphone **10**. For example, according to various embodiments, as shown in the process flow of FIG. **5**, the host server **40** may be programmed, at step **50**, to make a determination, based on the current data rate for the earphone **10** and the size of the update, whether the update should be pushed to the earphone **10** wirelessly (e.g., via the WLAN **30***a* in FIG. **2**D). If the update is too large and/or the current data rate is too low that the performance of the earphone **10** will be adversely affected, the host server **40** may refrain from pushing the update to the earphone **10** wirelessly and wait instead to download the update to the client computing device **202** at step **51**. Conversely, if the host server **40** determines that, given the size of the update and the current data rate for the earphone **10** that the performance of the earphone **10** will not be adversely affected, the host server **40** may transmit the update wirelessly to the earphone **10** at step **52**.

As mentioned above, the processor unit **114** of the speakerphones **14** may be programmed, via firmware stored in the memory **120**, **122**, to have the ability to transition automatically from the ad hoc wireless network **24** to an infrastructure wireless network **30** (such as a WLAN) when the quality of the signal on the ad hoc wireless network **24** degrades below a suitable threshold (such as when the data source **20** is out of range for an ad hoc wireless network). In that case, the earphone **10** and the data source **20** may connect to a common infrastructure wireless network (e.g., WLAN) (see, for example, FIGS. **2**B-**2**C). Through the web site for the earphone **10**, described above, the user could specify a priority of infrastructure wireless networks **30** for the data source **20** and the earphone **10** to connect to when the ad hoc wireless network **24** is not available. For example, the user could specify a WLAN servicing his/her residence first, a WLAN servicing his/her place of employment second, etc. During the time that the earphone **10** and the data source **20** are connected via the ad hoc wireless network **24**, the earphone **10** and the data source **20** may exchange data regarding which infrastructure networks are in range. When the earphone **10** and the data source **20** are no longer in range for the ad hoc wireless network **24** (that is, for example, the signals between the device degrade below an acceptable level), they may both transition automatically to the highest prioritized infrastructure wireless network whose signal strength is above a certain threshold level. That way, even though the earphone **10** and the data source **20** are out of range for the ad hoc wireless network **24**, the earphone **10** may still receive the streaming audio from the data source **20** via the infrastructure wireless network **30** (see FIGS. **2**B-**2**C).

When none of the preferred infrastructure networks is in range, the earphone **10** may connect automatically to the host server **40** via an available infrastructure wireless network **30** (see FIG. **2**D), e.g., the infrastructure wireless network **30** having the highest RSSI and to which the earphone **10** is authenticated to use. The host server **40**, as mentioned above, may transmit IP addresses to the earphone **10** for streaming digital audio content servers **70** or the host sever **40** may stream digital audio to the earphone **10** itself when in this communication mode.

FIG. **6** is a diagram of the process flow, according to one embodiment, implemented by the transceiver circuit **100** of the earphone **10**. The process shown in FIG. **6** may be implemented in part by the processor unit **114** executing firmware stored in a memory unit **120**, **122** of the transceiver circuit **100**. At step **61**, the earphone **10** may determine if it can communicate with the data source **20** via an ad hoc wireless network **24**. That is, the earphone **10** may determine if the strength of the wireless signals from the data source **20** exceed some minimum threshold. If so, the data source **20** and the earphone **10** may communicate wirelessly via the ad hoc wireless network **24** (see FIG. **2**A). While in this communication mode, at step **62**, the data source **20** and the earphone **10** also may exchange data regarding the local infrastructure wireless networks, if any, in the range of the data source **20** and the earphone **10**, respectively. For example, the earphone **10** may transmit the ID of local infrastructure wireless networks **30** that the earphone **10** can detect whose signal strength (e.g., RSSI) exceeds some minimum threshold level. Similarly, the data source **20** may transmit the ID the local infrastructure wireless networks **30** that the data source **20** can detect whose signal strength (e.g.,

RSSI) exceeds some minimum threshold level. The earphone **10** may save this data in a memory unit **120**, **122**. Similarly, the data source **20** may store in memory the wireless networks that the earphone **10** is detected.

The data source **20** and the earphone **10** may continue to communicate via the ad hoc wireless network mode **24** until they are out of range (e.g., the signal strengths degrade below a minimum threshold level). If an ad hoc wireless network **24** is not available at block **61**, the transceiver circuit **100** and the data source **20** may execute a process, shown at block **63**, to connect to the user's highest prioritized infrastructure wireless network **30**. For example, of the infrastructure wireless networks whose signal strength exceeded the minimum threshold for both the earphone **10** and the data source **20** determined at step **62**, the earphone **10** and the data source **20** may both transition to the infrastructure wireless network **30** having the highest priority, as previously set by the user (seen FIGS. **2B-2C**, for example). For example, if the user's highest prioritized infrastructure wireless network **30** is not available, but the user's second highest prioritized infrastructure wireless network **30** is, the earphone **10** and the data source **20** may both transition automatically to the user's second highest prioritized infrastructure wireless network **30** at block **64**. As shown by the loop with block **65**, the earphone **10** and the data source **20** may continue to communicate via one of the user's prioritized infrastructure wireless networks **30** as long as the infrastructure wireless network **30** is available. If the infrastructure wireless network becomes unavailable, the process may return to block **61**.

If, however, no ad hoc wireless network and none of the user's prioritized infrastructure wireless networks are available, the earphone **10** may transition automatically to connect to the host server **40** at block **66** (see FIG. **2D**) using an available infrastructure wireless network **30**. At block **67**, the host server **40** may transmit an IP address to the earphone **10** for one of the streaming digital audio content servers **70**, and at block **68** the earphone **10** may connect to the streaming digital audio content server **70** using the received IP address. At step **69**, as long as the earphone **10** is connected to the streaming digital audio content server **70**, the earphone **10** may continue to communicate in this mode. However, if the earphone **10** loses its connection to the digital audio content server **70**, the process may return to block **61** in one embodiment. As mentioned above, at block **67**, instead of sending an IP address for a streaming digital audio content server **70**, the host server **40** may stream digital audio to the earphone **10**. The user, when configuring their earphone **10** preferences via the web site, may specify and/or prioritize whether the host server **40** is to send IP addresses for the streaming digital audio content servers **70** and/or whether the host server **40** is to stream audio to the earphone **10** itself.

In another embodiment, the earphone **10** may be programmed to transition automatically to the host server **40** when the earphone **10** and the data source **20** are not in communication via the ad hoc wireless network **24**. That is, in such an embodiment, the earphone **10** may not try to connect via a local infrastructure wireless network **30** with the data source **20**, but instead transition automatically to connect to the host server **40** (see FIG. **2D**).

In various embodiments, as shown in FIG. **1B**, the button **11** or other user selection device that allows the wearer of the earphone **10** to indicate approval and/or disapproval of songs or other audio files listened to by the wearer over an Internet radio station. The approval/disapproval rating, along with metadata for the song received by the earphone **10** with the streaming audio, may be transmitted from the transceiver circuit **100** of the earphone **10** back to the host server **40**, which may log the songs played as well as the ratings for the various songs/audio files. In addition to being able to view the logs at the website, the host server **40** (or some other server) may send an email or other electronic communication to the earphone user, at a user specified email address or other address, which the user might access from their client communication device **50** (see FIG. **2D**). The email or other electronic communication may contain a listing of the song/audio files for which the user gave approval ratings using the button **11** or other user selection device. Further, the email or other electronic communication may provide a URL link for a URL at which the user could download song/audio files that the user rated (presumably song/audio files for which the user gave an approval rating). In some instances, the user may be required to pay a fee to download the song/audio file.

The user song ratings also may be used by the host server **40** to determine the user's musical preferences and offer new music that the user might enjoy. More details about generating user play lists based on song ratings may be found in published U.S. patent application Pub. No. 2006/0212444, Pub. No. 2006/0206487, and Pub. No. 2006/0212442, and U.S. Pat. No. 7,003,515, which are incorporated herein by reference in their entirety.

In addition or alternatively, the user could log onto a web site hosted by the host server **40** (or some other server) to view the approval/disapproval ratings that the user made via the button **11** on the earphone **10**. The web site may provide the user with the option of downloading the rated songs/audio files (for the host server **40** or some other server system) to their client computer device **50**. The user could then have their earphone **10** connect to their client computer device **50** as a data source **20** via an ad hoc wireless network **24** (see FIG. **2A**) or via an infrastructure wireless network (see FIGS. **2B-2D**) to listen to the downloaded songs. In addition, the user could download the song files from their client computer device **50** to their DAP and listen to the downloaded song files from their DAP by using their DAP as the data source **20** in a similar manner.

Another application of the headsets may be in vehicles equipped with Wi-Fi or other wireless network connectivity. Published PCT application WO 2007/136620, which is incorporated herein by reference, discloses a wireless router for providing a Wi-Fi or other local wireless network for a vehicle, such as a car, truck, boat, bus, etc. In a vehicle having a Wi-Fi or other local wireless network, the audio for other media systems in the vehicle could be broadcast over the vehicle's wireless network. For example, if the vehicle comprises a DVD player, the audio from the DVD system could be transmitted to the router and broadcast over the vehicle's network. Similarly, the audio from terrestrial radio stations, a CD player, or an audio cassette player could be broadcast over the vehicle's local wireless network. The vehicle's passengers, equipped with the earphones **10**, could cycle through the various audio broadcasts (including the broadcasts from the vehicle's media system as well as broadcasts from the host server **40**, for example) using a selection button **11** on the earphone **10**. The vehicle may also be equipped with a console or terminal, etc., through which a passenger could mute all of the broadcasts for direct voice communications, for example.

As described above, the earphones **10** may also include a microphone **104**, as shown in the example of FIG. **9**. The headset **90** shown in FIG. **9** includes two earphones **10**, both of which may include a transceiver circuit **100** or only one

of which may include the transceiver circuit, as discussed above. The microphone **104** could be used to broadcast communications from one earphone wearer to another earphone wearer. For example, one wearer could activate the microphone by pressing a button **92** on the headset **90**. The headset **90** may then transmit a communication via an ad hoc wireless network **24** or other wireless network to a nearby recipient (or recipients) equipped with a headset **90** with a transceiver circuit **100** in one or both of the earphones **10**. When such communication is detected by the recipient's headset **90**, the streaming audio received over the wireless network by the recipient's headset **90** may be muted, and the intercom channel may be routed to the transducer(s) of the recipient's headset **90** for playing for the recipient. This functionality may be valuable and useful where multiple wearers of the headsets **90** are in close proximity, such as on motorcycles, for example.

Another exemplary use of the earphones **10** is in a factory, warehouse, construction site, or other environment that might be noisy. Persons (e.g., workers) in the environment could use the earphones **10** for protection from the surrounding noise of the environment. From a console or terminal, a person (e.g., a supervisor) could select a particular recipient for a communication over the Wi-Fi network (or other local wireless network). The console or terminal may have buttons, dials, or switches, etc., for each user/recipient, or it could have one button or dial through which the sender could cycle through the possible recipients. In addition, the console or terminal could have a graphical user interface, through which the sender may select the desired recipient(s).

As mentioned above, the earphones **10** may comprise a USB port. In one embodiment, as shown in FIG. **11**, the user may use an adapter **150** that connects to the USB port of each earphone **10**. The adapter **150** may also have a plug connector **152**, such as a 3.5 mm jack, which allows the user to connect the adapter **150** to devices having a corresponding port for the connector **152**. When the earphones **10** detect a connection via their USB interfaces in such a manner, the Wi-Fi (or other wireless protocol) components may shut down or go into sleep mode, and the earphones **10** will route standard headphone level analog signals to the transducer(s) **106**. This may be convenient in environments where wireless communications are not permitted, such as airplanes, but where there is a convenient source of audio contact. For example, the adapter **150** could plug into a person's DAP. The DSP **118** of the earphone **10** may still be operational in such a non-wireless mode to provide noise cancellation and any applicable equalization.

The examples presented herein are intended to illustrate potential and specific implementations of the embodiments. It can be appreciated that the examples are intended primarily for purposes of illustration for those skilled in the art. No particular aspect of the examples is/are intended to limit the scope of the described embodiments.

According to various embodiments, therefore, the present invention is directed to an earphone **10** that comprises a body **12**, where the body **12** comprises: (i) at least one acoustic transducer **106** for converting an electrical signal to sound; (ii) an antenna **108**; and (iii) a transceiver circuit **100** in communication with the at least one acoustic transducer **106** and the antenna **108**. The transceiver circuit **100** is for receiving and transmitting wireless signals via the antenna **108**, and the transceiver circuit **100** is for outputting the electrical signal to the at least one acoustic transducer **106**. The wireless transceiver circuit also comprises firmware, which when executed by the transceiver circuit, causes the transceiver circuit to: (i) receive digital audio wirelessly from a data source **20** via an ad hoc wireless network **24** when the data source **20** is in wireless communication range with the earphone **10** via the ad hoc wireless network **24**; and (ii) when the data source **20** is not in wireless communication range with the earphone **10** via the ad hoc wireless network **24**, transition automatically to receive digital audio via an infrastructure wireless network **30**.

According to various implementations, the data source may comprise a portable digital audio player, such as an MP3 player, iPod, or laptop computer, or a nonportable digital audio player, such as a personal computer. In addition, the transceiver circuit **100** may comprise: (i) a wireless communication module **110** (such as a Wi-Fi or other wireless communication protocol module); (ii) a processor unit **114** in communication with the wireless communication module **110**; (iii) a non-volatile memory unit **122** in communication with the processor unit **114**; and (iv) a volatile memory **120** unit in communication with the processor unit **114**. The infrastructure wireless network may comprise a WLAN. The transceiver circuit **100** may receive digital audio from the data source **20** via the infrastructure wireless network **30** when the data source **20** is not in wireless communication range with the earphone **10** via the ad hoc wireless network **24**. The transceiver circuit firmware, when executed by the transceiver circuit **100**, may cause the transceiver circuit **100** of the earphone **10** to transition automatically to a pre-set infrastructure wireless network **30** that the data source **20** transitions to when the data source **20** is not in wireless communication range with the earphone **10** via the ad hoc wireless network **24** and when the pre-set infrastructure wireless network **30** is in range of both the earphone **10** and the data source **20**. In addition, the transceiver circuit firmware, when executed by the transceiver circuit **100**, may cause the transceiver circuit **100** of the earphone **10** to transmit data via the ad hoc wireless network **24** to the data source **20** regarding one or more infrastructure wireless networks **30** detected by the transceiver circuit **100** when the earphone **10** and the data source **20** are communicating via the ad hoc wireless network **24**.

In addition, the transceiver circuit firmware, when executed by the transceiver circuit **100**, may cause the transceiver circuit **100** of the earphone **10** to connect to a host server **40** via an available infrastructure wireless network **30** when the data source **20** is not in wireless communication range with the earphone **10** via the ad hoc wireless network **24**. The earphone **10** may receive streaming digital audio from the host server **40** via the infrastructure wireless network **30**. In addition, the earphone **10** may receive a first network address for a first streaming digital audio content server **70** from the host server **40** via the infrastructure wireless network **30**. In addition, the earphone **10** may comprise a user control, such as button **11**, dial, pressure switch, or other type of user control, that, when activated, causes the earphone **10** to transmit an electronic request via the infrastructure wireless network **30** to the host server **40** for a second network address for a second streaming digital audio content server **70**.

In other embodiments, the present invention is directed to a system that comprises: (i) a data source **20** for wirelessly transmitting streaming digital audio; and (ii) a wireless earphone **10** that is in wireless communication with the data source **20**. In yet other embodiments, the present invention is directed to a communication system that comprises: (i) a host server **40**; (ii) a first streaming digital audio content server **70** that is connected to the host server **40** via a data network **42**; and (iii) a wireless earphone **10** that is in communication with the host server **40** via a wireless

network **30**. The host server **40** is programmed to transmit to the earphone **10** a first network address for the first streaming digital audio content server **70** on the data network **42**. The host server **40** and the streaming digital audio content server(s) **70** each may comprise one or more processor circuits and one or more memory circuits (e.g., ROM circuits and/or RAM circuits).

In yet another embodiment, the present invention is directed to a headset that comprises: (i) a first earphone **10***a* that comprises one or more acoustic transducers **10***b* for converting a first electrical signal to sound; and (ii) a second earphone **10***b*, connected to the first earphone **10***a*, wherein the second earphone **10***b* comprises one or more acoustic transducers **10***b* for converting a second electrical signal to sound. In one embodiment, the first earphone **10***a* comprises: (i) a first antenna **108**; and (ii) a first transceiver circuit **100** in communication with the one or more acoustic transducers **106** of the first earphone **10***a* and in communication with the first antenna **108**. The first transceiver circuit **100** is for receiving and transmitting wireless signals via the first antenna **108**, and for outputting the first electrical signal to the one or more acoustic transducers **10***b* of the first earphone **10***a*. The first transceiver circuit **100** also may comprise firmware, which when executed by the first transceiver circuit **100**, causes the first transceiver circuit **100** to: (i) receive digital audio wirelessly from a data source **20** via an ad hoc wireless network **24** when the data source **20** is in wireless communication range with the first earphone **10***a* via the ad hoc wireless network **24**; and (ii) when the data source **20** is not in wireless communication range with the first earphone **10***a* via the ad hoc wireless network **24**, transition automatically to receive digital audio via an infrastructure wireless network **30**.

In various implementations, the headset further may comprise a head band **19** that is connected to the first and second earphones **10**. In addition, the headset **19** further may comprise a microphone **104** having an output connected to the first transceiver circuit **100**. In one embodiment, the first transceiver circuit **100** is for outputting the second electrical signal to the one or more acoustic transducers **106** of the second earphone **10***b*. In another embodiment, the second earphone **10***b* comprises: (i) a second antenna **108**; and (ii) a second transceiver circuit **100** in communication with the one or more acoustic transducers **106** of the second earphone **10***b* and in communication with the second antenna **108**. The second transceiver circuit **100** is for receiving and transmitting wireless signals via the second antenna **108**, and for outputting the second electrical signal to the one or more acoustic transducers **106** of the second earphone **10***b*. The second transceiver circuit **100** may comprise firmware, which when executed by the second transceiver circuit **100**, causes the second transceiver circuit **100** to: (i) receive digital audio wirelessly from the data source **20** via the ad hoc wireless network **24** when the data source **20** is in wireless communication range with the second earphone **10***b* via the ad hoc wireless network **24**; and (ii) when the data source **20** is not in wireless communication range with the second earphone **10***b* via the ad hoc wireless network **24**, transition automatically to receive digital audio via the infrastructure wireless network **30**.

In addition, according to various embodiments, the first earphone **10***a* may comprise a first data port and the second earphone **10***b* may comprise a second data port. In addition, the headset may further comprise an adapter or dongle **150** connected to the first data port of the first earphone **10***a* and to the second data port of the second earphone **10***b*, wherein

the adapter **150** comprises an output plug connector **152** for connecting to a remote device.

In addition, according to other embodiments, the present invention is directed to a method that comprises the steps of: (i) receiving, by a wireless earphone, via an ad hoc wireless network, digital audio from a data source when the data source is in wireless communication with the earphone via the ad hoc wireless network; (ii) converting, by the wireless earphone, the digital audio to sound; and (iii) when the data source is not in wireless communication with the earphone, transitioning automatically, by the earphone, to receive digital audio via an infrastructure wireless network.

In various implementations, the step of transitioning automatically by the earphone to receive digital audio via an infrastructure wireless network may comprises transitioning automatically to receive digital audio from the data source via an infrastructure wireless network when the data source is not in wireless communication range with the earphone via the ad hoc wireless network. In addition, the method may further comprise the step of receiving by the wireless earphone from the data source via the ad hoc wireless network data regarding one or more infrastructure wireless networks detected by data source when the earphone and the data source are communicating via the ad hoc wireless network.

In addition, the step of transitioning automatically by the earphone to receive digital audio via an infrastructure wireless network comprises may transitioning automatically to receive digital audio from a host sever via the infrastructure wireless network when the data source is not in wireless communication range with the earphone via the ad hoc wireless network. Additionally, the step of transitioning automatically by the earphone to receive digital audio via an infrastructure wireless network may comprise: (i) receiving, by the wireless earphone via the infrastructure wireless network, from a host server connected to the infrastructure wireless network, a network address for a streaming digital audio content server; and (ii) connecting, by the wireless earphone, to the streaming digital audio content server using the network address received from the host server.

It is to be understood that the figures and descriptions of the embodiments have been simplified to illustrate elements that are relevant for a clear understanding of the embodiments, while eliminating, for purposes of clarity, other elements. For example, certain operating system details for the various computer-related devices and systems are not described herein. Those of ordinary skill in the art will recognize, however, that these and other elements may be desirable in a typical processor or computer system. Because such elements are well known in the art and because they do not facilitate a better understanding of the embodiments, a discussion of such elements is not provided herein.

In general, it will be apparent to one of ordinary skill in the art that at least some of the embodiments described herein may be implemented in many different embodiments of software, firmware and/or hardware. The software and firmware code may be executed by a processor or any other similar computing device. The software code or specialized control hardware that may be used to implement embodiments is not limiting. For example, embodiments described herein may be implemented in computer software using any suitable computer software language type. Such software may be stored on any type of suitable computer-readable medium or media, such as, for example, a magnetic or optical storage medium. The operation and behavior of the embodiments may be described without specific reference to specific software code or specialized hardware components.

The absence of such specific references is feasible, because it is clearly understood that artisans of ordinary skill would be able to design software and control hardware to implement the embodiments based on the present description with no more than reasonable effort and without undue experimentation.

Moreover, the processes associated with the present embodiments may be executed by programmable equipment, such as computers or computer systems and/or processors. Software that may cause programmable equipment to execute processes may be stored in any storage device, such as, for example, a computer system (nonvolatile) memory, an optical disk, magnetic tape, or magnetic disk. Furthermore, at least some of the processes may be programmed when the computer system is manufactured or stored on various types of computer-readable media.

A "computer," "computer system," "host," "host server," "server," or "processor" may be, for example and without limitation, a processor, microcomputer, minicomputer, server, mainframe, laptop, personal data assistant (PDA), wireless e-mail device, cellular phone, pager, processor, fax machine, scanner, or any other programmable device configured to transmit and/or receive data over a network. Such components may comprise: one or more processor circuits; and one more memory circuits, including ROM circuits and RAM circuits. Computer systems and computer-based devices disclosed herein may include memory for storing certain software applications used in obtaining, processing, and communicating information. It can be appreciated that such memory may be internal or external with respect to operation of the disclosed embodiments. The memory may also include any means for storing software, including a hard disk, an optical disk, floppy disk, ROM (read only memory), RAM (random access memory), PROM (programmable ROM), EEPROM (electrically erasable PROM) and/or other computer-readable media.

In various embodiments disclosed herein, a single component may be replaced by multiple components and multiple components may be replaced by a single component to perform a given function or functions. Except where such substitution would not be operative, such substitution is within the intended scope of the embodiments. Any servers described herein, such as the host server **40**, for example, may be replaced by a "server farm" or other grouping of networked servers (such as server blades) that are located and configured for cooperative functions. It can be appreciated that a server farm may serve to distribute workload between/among individual components of the farm and may expedite computing processes by harnessing the collective and cooperative power of multiple servers. Such server farms may employ load-balancing software that accomplishes tasks such as, for example, tracking demand for processing power from different machines, prioritizing and scheduling tasks based on network demand and/or providing backup contingency in the event of component failure or reduction in operability.

While various embodiments have been described herein, it should be apparent that various modifications, alterations, and adaptations to those embodiments may occur to persons skilled in the art with attainment of at least some of the advantages. The disclosed embodiments are therefore intended to include all such modifications, alterations, and adaptations without departing from the scope of the embodiments as set forth herein.

What is claimed is:

1. A system comprising:

a mobile, digital audio player that stores digital audio content; and

a headphone assembly, separate from and in wireless communication with the mobile digital audio player, wherein the headphone assembly comprises:

first and second earphones, wherein each of the first and second earphones comprises an acoustic transducer;

an antenna for receiving wireless signals from the mobile, digital audio player via one or more ad hoc wireless communication links;

a wireless communication circuit connected to the at least one antenna, wherein the at least one wireless communication circuit is for receiving and transmitting wireless signals to and from the headphone assembly;

a processor;

a rechargeable battery for powering the headphone assembly; and

a microphone for picking up utterances by a user of the headphone assembly; and

a remote, network-connected server that is in wireless communication with the mobile, digital audio player;

wherein the mobile, digital audio player is for transmitting digital audio content to the headphone assembly via the one or more ad hoc wireless communication links, such that the digital audio content received by the headphone assembly from the mobile, digital audio player is playable by the first and second earphones; and

wherein the processor is for, upon activation of a user-control of the headphone assembly, initiating transmission of a request to the remote, network-connected server.

2. The system of claim **1**, wherein:

in a first audio play mode, the first and second earphones play audio content stored on the mobile, digital audio player and transmitted to the headphone assembly from the mobile, digital audio player via the one or more ad hoc wireless communication links; and

in a second audio play mode, the earphones play audio content streamed from the remote, network-connected server.

3. The system of claim **2**, wherein the processor of the headphone assembly is further for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

4. The system of claim **3**, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

5. The system of claim **2**, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital

audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

6. The system of claim 1, wherein the processor of the headphone assembly is further for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

7. The system of claim 6, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

8. The system of claim 1, wherein upon activation of the microphone by the user, data are transmitted about the headphone assembly to a remote device.

9. The system of claim 1, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

10. The system of claim 1, the remote, network-connected server transmits firmware upgrades to the headphone assembly.

11. The system of claim 1, wherein:

the wireless communication circuit is located in the first earphone; and

the headphone assembly further comprises a connection wire between the first and second earphones to carry the received digital audio content from the first earphone to the second earphone.

12. The system of claim 11, wherein:

in a first audio play mode, the first and second earphones play audio content stored on the mobile, digital audio player and transmitted to the headphone assembly from the mobile, digital audio player via the one or more ad hoc wireless communication links; and

in a second audio play mode, the earphones play audio content streamed from the remote, network-connected server.

13. The system of claim 12, wherein the processor of the headphone assembly is further for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

14. The system of claim 13, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

15. The system of claim 12, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

16. The system of claim 11, wherein the processor of the headphone assembly is further for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

17. The system of claim 16, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

18. The system of claim 11, wherein upon activation of the microphone by the user, data are transmitted about the headphone assembly to a remote device.

19. The system of claim 11, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

20. The system of claim 11, wherein the headphone assembly further comprises a headband, and wherein the headband carries the connection wire.

21. The system of claim 20, wherein:

in a first audio play mode, the first and second earphones play audio content stored on the mobile, digital audio player and transmitted to the headphone assembly from the mobile, digital audio player via the one or more ad hoc wireless communication links; and

in a second audio play mode, the earphones play audio content streamed from the remote, network-connected server.

22. The system of claim 21, wherein the processor of the headphone assembly is further for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

23. The system of claim 22, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

24. The system of claim 21, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

25. The system of claim 20, wherein the processor of the headphone assembly is further for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

26. The system of claim 25, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

27. The system of claim 20, wherein upon activation of the microphone by the user, data are transmitted about the headphone assembly to a remote device.

28. The system of claim 20, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

29. The system of claim 11, wherein each of the first and second earphones comprises:

an adjustable, curved hanger bar that sits upon an upper external curvature of a user's ear, behind the an upper portion of an auricula of the user's ear, when the headphone assembly is worn by the user; and

a body connected to the hanger bar, wherein the earphone extends from the body into the user's ear when the headphone assembly is worn by the user.

30. The system of claim 29, wherein:

in a first audio play mode, the first and second earphones play audio content stored on the mobile, digital audio player and transmitted to the headphone assembly from the mobile, digital audio player via the one or more ad hoc wireless communication links; and

in a second audio play mode, the earphones play audio content streamed from the remote, network-connected server.

31. The system of claim 30, wherein the processor of the headphone assembly is further for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

32. The system of claim 31, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

33. The system of claim 30, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

34. The system of claim 29, wherein the processor of the headphone assembly is further for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

35. The system of claim 34, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

36. The system of claim 29, wherein upon activation of the microphone by the user, data are transmitted about the headphone assembly to a remote device.

37. The system of claim 29, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

38. The system of claim 11, wherein the remote, network-connected server transmits firmware upgrades to the headphone assembly.

39. The system of claim 11, wherein each of the first and second earphones comprise earbuds.

40. The system of claim **1**, wherein each of the first and second earphones comprises:

at least one acoustic transducer;

a wireless communication circuit;

a body portion that sits at least partially in an ear of the user when the headphone assembly is worn by the user; and

an elongated portion that extends from the body portion.

41. The system of claim **40**, further comprising a docking station for charging at least one of the first and second earphones.

42. The system of claim **41**, wherein:

in a first audio play mode, the first and second earphones play audio content stored on the mobile, digital audio player and transmitted to the headphone assembly from the mobile, digital audio player via the one or more ad hoc wireless communication links; and

in a second audio play mode, the earphones play audio content streamed from the remote, network-connected server.

43. The system of claim **42**, wherein the processor of the headphone assembly is further for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

44. The system of claim **43**, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

45. The system of claim **42**, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

46. The system of claim **41**, wherein the processor of the headphone assembly is further for:

processing audible utterances by the user picked up by the microphone in response to activation of the microphone by the user; and

transmitting a communication based on the audible utterances via the one or more ad hoc wireless communication links.

47. The system of claim **46**, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

48. The system of claim **41**, wherein upon activation of the microphone by the user, data are transmitted about the headphone assembly to a remote device.

49. The system of claim **48**, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

50. The system of claim **41**, wherein:

the mobile, digital audio player is a first digital audio source;

the system further comprises a second digital audio source that is different from the first digital audio source; and

the headphone assembly transitions to play digital audio content received wirelessly from the second digital audio source via a second wireless communication link based on, at least, a signal strength level for the second wireless communication link.

51. The system of claim **40**, wherein the remote, network-connected server transmits firmware upgrades to the headphone assembly.

52. The system of claim **1**, wherein the headphone assembly further comprises first and second integrated circuits, wherein the first integrated circuit comprises the wireless communication circuit and the second integrated circuit, which is separate from the first integrated circuit, comprises the processor.

53. The system of claim **1**, wherein each of the first and second earphones comprises:

an adjustable, curved hanger bar that sits upon an upper external curvature of a user's ear, behind the an upper portion of an auricula of the user's ear, when the headphone assembly is worn by the user; and

a body connected to the hanger bar, wherein the earphone extends from the body into the user's ear when the headphone assembly is worn by the user.

54. The system of claim **1**, wherein each of the first and second earphones comprise earbuds.

55. The system of claim **1**, wherein each of the first and second earphones comprise on-ear speaker elements.

56. The system of claim **1**, wherein each of the first and second earphones comprise over-ear speaker elements.

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UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME LIMITATIONS

Case Number: 2023−1173, −1179, −1180, −1191

Short Case Caption: Koss Corp. v. Vidal

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